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User's Manual for ModSAF

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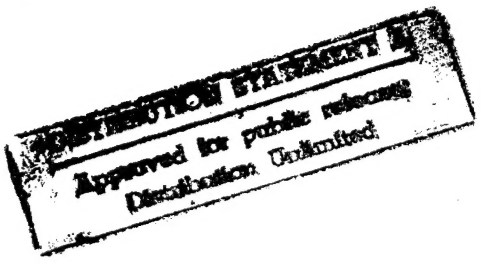

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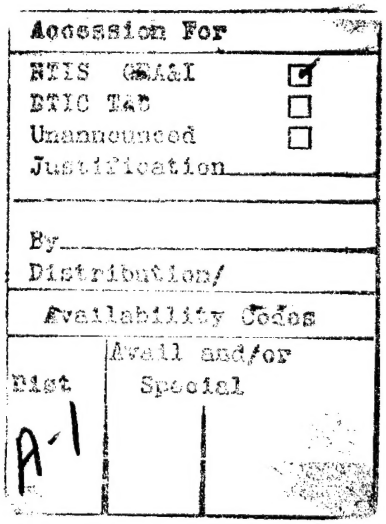

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How To Use This Manual

This manual describes features of the ModSAF and Logger user interfaces, and provides step-by-step user instructions. It can be used as a tutorial for beginning users or as a reference guide for more experienced users.

Used as a tutorial, it introduces the basic features, then moves gradually to the more complex ones. If you are unfamiliar with ModSAF, you can proceed sequentially through the manual, trying procedures. In each procedure, numbered instructions tell you what steps to perform and what happens on the screen as a result.

Used as a reference guide, this manual provides instructions for operations that are performed at the ModSAF and Logger user interface. Experienced users who merely need to refresh their memory can refer to the numbered steps in the appropriate chapter or appendix.

The manual contains the following chapters and appendices:

- ModSAF Overview - describes ModSAF.
- ModSAF Operation - gives instructions for starting and exiting the SAFstation and the SAFsim, and explains the start up and shut down procedures.
- Basic Tools of the ModSAF User Interface - shows the SAFstation screen layout and gives instructions for working with each screen section.
- Tactical Map View - gives instructions for altering the Map view and using terrain representation tools.
- Graphic Operations - gives instructions for creating, deleting, and editing graphics.
- Unit Operations - gives instructions for creating, deleting, and editing units.
- Mission Operations - gives instructions for creating, assigning, and editing missions.
- Combat Support - gives instructions for using artillery, minefields, and the fire support tool.
- Miscellaneous Commands - explains the choices offered by the `File`, `Show As`, `Local Force`, and `Special` commands.
- Miscellaneous Editors - describes the User Preference, PVD Controls, Stealth Controls, and Overlay editors.
- Additional Capabilities - describes special purpose functionality.
- ModSAF Configuration - explains ways to set up ModSAF.
- ModSAF Logger - gives operating instructions for the Logger program.
- Dynamic Virtual Worlds Enhancements - describes extensions to support environmental phenonema.

- Menu Component Operations - describes the data entry and editing procedures for the components appearing on pulldown menus, editor displays, and pop-up windows.
- Task Frames - describes the assignable task frames.
- Editable Tasks - describes tasks that can be modified.
- Recovery Operations - describes procedures for handling error messages and system failures.
- Exercises - gives practice exercises.

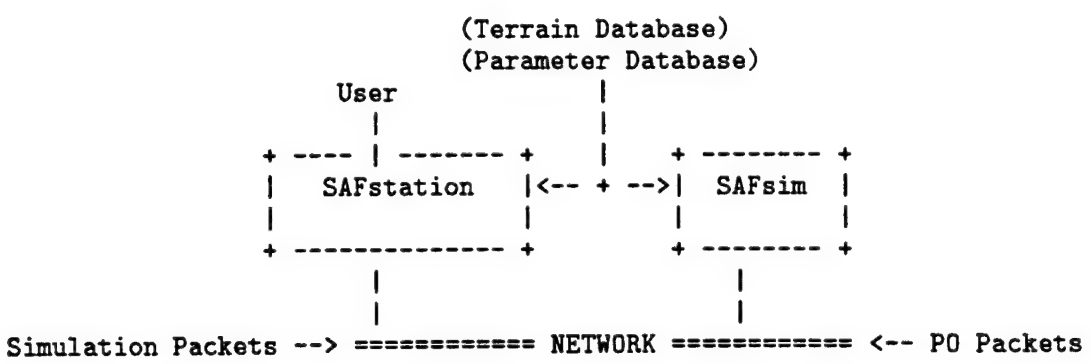
1 ModSAF Overview

ModSAF, or Modular Semi-Automated Forces, is the successor to the SIMNET and ODIN Semi-Automated Forces systems. It lets you create and control entities on a simulated battlefield. These entities replicate the outward behavior of their component vehicle and weapon systems to a level of realism sufficient for training and combat development.

1.1 ModSAF Components

The ModSAF architecture consists of three components: (1) SAFstation, (2) SAFsim, and (3) Logger. These components are typically run on separate computers distributed over a network, although the SAFsim and SAFstation can run on the same computer. The components communicate physical battlefield state and events among themselves through the simulation (DIS) protocol and command, control, and system information through the Persistent Object (PO) protocol.

The following figure shows SAFstation and SAFsim components communicating over a network via PO and simulation packets. These packets, containing bundles of data, are marked with the same exercise ID. SAFsim and SAFstation communicate command, control, and system information via *PO packets*. There are PO packets for bundling graphic, unit, message, model parameter, task, task frame, and mission data. When you create objects on the SAFstation, PO packets representing the state of each object are projected onto the network so that the objects they represent can be simulated by the SAFsim. SAFsim and SAFstation communicate physical battlefield state and events between themselves via *simulation packets*. There are simulation packets for bundling entity state, impact, collision, fire, initialization, radar, and weather data.



Modeling parameters used in the construction of the ModSAF system are contained in the Parameter Database. This set of parameter files allows modification of the ModSAF system without

further computer programming. Both the SAFstation and the SAFsim components have access to a Terrain Database.

The SAFstation Graphical User Interface (GUI) lets you create, load, and run scenarios to simulate a battlefield situation. It enables you to interact with the ModSAF system with menus and mouse-sensitive graphics facilities.

The SAFsim simulates objects known as ModSAF "entities". These simulated objects (such as planes and tanks) can behave autonomously. When a SAFsim simulates a unit, the SAFsim not only creates the entities in the unit, it also builds a structure corresponding to the unit hierarchy. You can then issue orders to top-level units or drop down the chain of command to give orders to subordinate units or individual vehicles. The SAFsim interprets these orders, then generates the appropriate unit and vehicle behavior and tactics without further user action. You can, however, override or interrupt any automated behavior.

1.2 Behavior Simulation

ModSAF entities can execute a realistic range of basic actions inherent to the type of vehicle simulated. For example, a tank can drive along a road and an aircraft can orbit. ModSAF entities can exhibit combat damage to their mobility and firepower according to the type of weapon used, the location and angle of incidence of the hit, and the range of weapon. Similarly, an entity's weapons system exhibits realistic rates of fire and trajectories, and resource depletion is accurately simulated for both fuel and ammunition. Other simulated capabilities include intervisibility, target detection, target identification, target selection, fire planning, and collision avoidance and detection. These capabilities are based on, but not limited to, such appropriate realistic factors as range, motion, activity, visibility, arc of attention, direction, orders, and evaluation of threat.

ModSAF makes use of verified, validated, and accredited (VV&A) models for damage assessment, delivery accuracy, and target acquisition. These models are compatible with existing validated Army combat models and can use validated classified data. Analysis of VVA-specific PDUs insures that all phases of the model are correct. These VVA-specific PDUs contain internal parameters necessary for a complete evaluation of the correctness of the model. For example, the Direct Fire Damage Assessment VVA PDU provides all of the calculated data used by the model.

ModSAF's units can take advantage of situational awareness and opportunities for cover and concealment when they perform tactical movement and combat. Its platoons can perform advanced platoon behaviors and can be lead by a platoon leader in a manned simulator. ModSAF combat

service support capabilities give ModSAF vehicles the ability to tow, repair, or resupply other vehicles.

ModSAF governs automated behavior with *tasks* and *task frames*. A task is a behavior performed by a ModSAF entity or unit on the battlefield. A set of representative tasks is defined in terms of their characteristic parameters. The ModSAF system provides default values for task parameters drawn from standard military doctrine. These default values can be modified. The task frames group related tasks that run simultaneously. Task frames are typically composed of move, shoot, coordinate, and react tasks.

You can control ModSAF behavior by: (1) creating preplanned missions, (2) setting up reactions, and (3) issuing immediate commands.

- *Preplanned missions* are created by filling out execution matrices. The execution matrix is based on a standard Army planning tool that allows officers to sequence and synchronize the actions of the units they are commanding. The execution matrix divides the battle into phases and indicates what each unit should be doing in each phase. It both defines and sequences the mission phases.
- *Reactions* are implemented with each reactive trigger represented by a task. An example of a reactive trigger is the `Actions On Contact` task. This task monitors enemy activity and triggers the appropriate reaction based on factors such as enemy classification and strength. Reactions stop when the conditions that invoked them no longer exist. You can also override a reaction at any time without having the reaction be reinvoked. Reactions are parameterized so that you can define situations and map them to reactions interactively.
- *Immediate commands* (interventions) let you modify an existing task or assign a new one. They are similar to military FRAGmentary Orders (FRAGOs) since they modify, rather than replace, a preplanned mission.

Displays show the current state of a unit's mission. You can interrupt the current mission to perform new tasks and then return to the original mission. You can also modify the parameters of the current mission.

Issuing immediate commands in ModSAF is enhanced by the use of *direct manipulation interfaces* which consist of graphical control measures that are computed by the simulation and then displayed for modification purposes. For example, vehicle position and orientation when occupying a position are computed from parameters in the `Occupy Position` task. The results are then presented graphically by a directed point object on the SAFstation display. If you do not approve of the results, you can select the directed point object with the mouse and drag it to a new location.

You can also change the orientation. The vehicle will automatically move to the new point and take up the new orientation.

2 ModSAF Operation

This chapter describes how to run ModSAF and includes explanations of some of the commonly used command line options. It also describes how to start up and shut down a ModSAF system.

The usual ModSAF configuration requires a SAFstation computer for the user interface processing, plus a SAFsim computer for the simulation processing. It is possible, however, to configure ModSAF so that both the user interface and simulation functions are run on one computer. This is referred to as a "pocket" system and is useful when learning how to operate ModSAF or when running a very small exercise. Note that ModSAF cannot be run in the background.

To run ModSAF, you need to access the directory that the ModSAF object code resides in. Typically, this could be named '**usr/staff/<yourname>/modsaf/common/src/ModSAF**'. The ModSAF object code is named **modsaf_<platform>** (e.g., modsaf_sgi, modsaf_sgi_5_2, modsaf_sun4, or modsaf_mips).

When you start the modsaf program, it can take several minutes for the software to determine the state of all the other machines on the network. When you quit, wait at least 45 seconds before restarting.

The ModSAF user interface uses the X resource manager for selection of layout, sizing, and coloring. The resources are found in the file '**common/src/ModSAF/ModSAF**'.

2.1 Getting Started

You can run ModSAF on one machine as a combined SAFstation/SAFsim to view the user interface and perform the exercises in this manual. By running this "pocket" system in standalone (without the network) mode, you can practice operating ModSAF.

To run the ModSAF program on one computer in standalone mode:

1. Go to the '**common/src/ModSAF**' directory.
2. Enter: **modsaf_<platform> -nonet**
3. To exit the ModSAF pocket program, click **File** in the Menu Bar at the top of the screen. Click **Quit** in the resulting pulldown menu.

Note: the command, **modsaf_sgi -nonet**, tells the modsaf program to bring up the GUI, to simulate objects and to run without the network. If you do want network use, don't include the **-nonet** option. (By default ModSAF will project both simulation and PO packets on exercise 1. To use a different simulation ID or PO database ID, you need to supply them by entering a command line option.)

2.2 Using Command Line Options

The ModSAF Version Description Document (VDD) describes most of the command line options. The frequently used options include:

- **-terrain <terrain database name>** tells the program to read in a terrain database other than its default.
- **-exercise <ID #>** tells the program to read and write simulation packets with the named exercise ID. If the **-exercise** option is not used, simulation packets are projected on exercise 1 by default.
- **-database <ID #>** tells the program to read and write PO packets with the named database ID. If the **-database** option is not used PO packets belong to PO database 1 by default.

There are options for setting network arguments:

- If you are running at a site that uses the SIMNET protocol, use the following options: **-assoc -noudp -simnet**.
- If you are running at a site that uses the DIS 2.0.3 protocol, use the following options: **-udp -noassoc -dis -version 2.0.3**.

To view on-line help about the ModSAF options:

1. Go to the '**common/src/ModSAF**' directory.
2. Enter: **modsaf_<platform> -help**.

2.3 Entering/Exiting the SAFstation

To run the SAFstation program from the ModSAF directory:

1. Enter: **modsaf_<platform> -gui -exercise <#> -database <#> -nosim**
   The following occurs:
   - **-gui** - Tells the program to bring up the user interface.
   - **-exercise <exercise #>** - Tells the program the simulation exercise number.
   - **-database <PO database #>** - Tells the program the PO database number.
   - **-nosim** - Tells the program not to simulate objects.

   Note: The command, **modsaf_sgi -gui -exercise 2 -database 4 -nosim**, tells the modsaf program to bring up the graphical user interface, to use simulation packets whose identifier is 2, and to read and write PO packets whose identifier is 4. The program will not simulate objects but will communicate via PO database 4 with a SAFsim on the network. That SAFsim will simulate the objects placed on the SAFstation.
2. Watch for the user interface to appear. This signals that the program is ready to accept commands.
3. To exit the SAFstation program, click **File** in the Menu Bar at the top of the screen. Click **Quit** in the resulting pulldown menu.

2.4 Entering/Exiting the SAFsim

To run the SAFsim program from the ModSAF directory:

1. Enter: **modsaf_<platform> -nogui -exercise <#> -database <#> -simulate**
   The following occurs:
   - **-nogui** - Tells the program to run without a user interface.
   - **-simulate** - Tells the program to simulate objects.
   - **-exercise** and **-database** - Sets a PO database and simulation exercise ID that match those of a SAFstation.

   Note: **modsaf_sgi -simulate -exercise 2 -database 4 -nogui** tells the program to simulate objects on exercise 2. It also tells the program to read and write PO packets whose exercise identifier is 4 and to avoid running the user interface process.
2. Watch for the computer prompt to appear as **modsaf@<machine name>**. This signals that the program is ready to simulate objects.
3. To exit the SAFsim program, type **quit** in response to the **modsaf@<machine name>** prompt.

2.5 Running ModSAF on a Single Computer

To run ModSAF as a combined SAFstation/SAFsim and use the network:

1. Go to the '`common/src/ModSAF`' directory.
2. Enter: `modsaf_<platform> -exercise <#> -database <#>`

   The following occurs:

   - `-exercise` - Sets a simulation exercise ID. Without this option, simulation packets are projected onto the network using simulation exercise 1.

     `-database` - Sets a PO database ID. Without this option, PO packets are projected onto the network using PO database id 1.
3. To exit the ModSAF pocket program, click `File` in the Menu Bar at the top of the screen. Click `Quit` in the resulting pulldown menu.

Note: The command, `modsaf_sgi -exercise 8 -database 9`, tells the modsaf program to project simulation packets with exercise ID 8 and PO packets with PO database ID 9. By default the `-gui` and and the `-sim` options are active to tell the ModSAF program to bring up the user interface and simulate objects.

2.6 Adjusting User Interface Privileges

There are four privilege level choices: Operator, Commander, Battlemaster, and SysOp (System Operator). All ModSAF commands are enabled at the SysOp privilege level. At other privilege levels, various commands are disabled. The Battlemaster level disables some file deletion commands. The Operator and Commander levels are the most restrictive. In addition to the Battlemaster restrictions, these levels disable commands to create units, load scenario or overlay files, and set SAFstation alignment.

Password protection applies to privilege changes. (The default password is '`foozball`'.) You can change the password. For example. to change your password to FOO, type:

```
cd common/src/ModSAF
cat > .password
FOO
^D
```

You can disable password protection by creating an empty '**.password**' file. To do this, type:

```
cd common/src/ModSAF
rm -f .password
touch .password
```

To select a privilege:

1. Click **Privilege** in the Menu Bar at the top of the SAFstation screen.
2. A pulldown menu of privilege level choices appears. (A recessed box in front of the privilege level indicates the current setting.) Select the setting you want.
3. If a pop-up display appears to request a password, type your site's password.

2.7 Starting the Computer System

Start up directions are platform-specific and are found in the documentation supplied with the hardware. Typically, the system startup procedure would include the following steps:

1. Make sure all cables are properly connected.
2. Turn on power to the display monitor (or console terminal) and the computer.
3. Enter **auto** to auto-boot the system in response to the monitor prompt (**>>**). When the login prompt appears, the machine is ready.
4. Login with the name and password assigned at your site.

2.8 Shutting Down the Computer System

Shut down directions are platform-specific and are found in the documentation supplied with the hardware. Typically, the system shutdown procedure would include the following steps:

1. Use the sysadm (system administration) machine management powerdown command to initiate shutdown of the operating system.
2. Answer **y**, when prompted for whether you want to do an express powerdown.
3. Wait for the monitor prompt to appear.

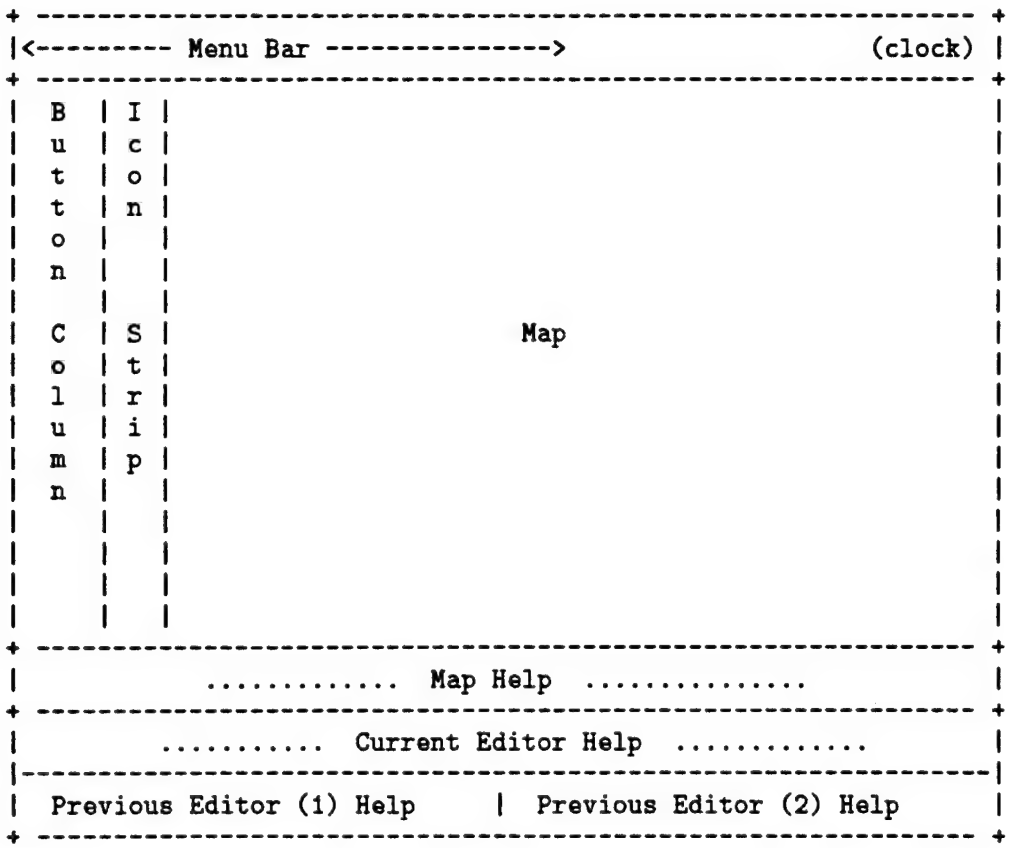
4. Turn off the display monitor (or console terminal) and the computer. Note: To protect the disk, ALWAYS do a software shutdown before doing a hardware shutdown.

3 Basic Tools of the ModSAF User Interface

The SAFstation user interface consists of a color monitor, a keyboard, and a mouse. The color monitor displays terrain and the current state of the battlefield (with friendly elements drawn in blue and enemy elements drawn in red). You can zoom and pan to any point on the color map and can display a variety of terrain features.

3.1 Using the Display

The SAFstation display supports the operations needed for issuing ModSAF commands. To view this display, go to the '`common/src/ModSAF`' directory and enter: `modsaf_<platform> -nonet`. The following figure shows the layout of the SAFstation screen when you bring up ModSAF. (Typically the Editor Area and Message Log are not displayed.)



The SAFstation screen consists of the following areas:

- Menu Bar - This area, across the top of the screen, contains commands to access pulldown menus and a clock that shows real time (not simulation time). When you select a menu command, a pulldown menu appears offering more commands or options. The menu commands are:

  File - Performs functions on scenarios, overlays, and user preferences.

  Map Scale - Changes the map scale.

  Map Features - Selects the terrain features to display.

  Show As - Changes the appearance of vehicle and unit icons on the map.

  Local Force - Sets the alignment of the SAFstation (friendly, enemy, or both).

  Force Designation - Set to correspond to the type of exercise being run. This only needs to be done when running a SIMNET exercise with manned simulators. See Section 11.3.2 [Simulator Activation], page 104.

  HHours - Implements a specified time to be used as a way of controlling when a unit performs the phases of its mission. This command has a pulldown menu only when an HHour clock has been defined.

  Special - Controls the map redrawing feature and the display of the Message Log and the Editor Area.

  Privilege - Sets the privilege level of the SAFstation (thus determining which buttons and menus are enabled or disabled).

  On Order - Starts a mission. This command appears only when needed.

- Button Column - This area, down the far left side of the screen, contains: a **Select** button at the top of the column, an **Editor Buttons** section beneath the Select button, and a **Map Buttons** section at the bottom. Only one button can be active or selected at a time in each section. See Section 3.5 [Using the Button Column], page 19.

  The **Select** button lets you select an existing object from the Map, or change modes from one button to another.

  Editor Buttons let you access editor menus. These buttons are marked with symbols, and are referred to in this document as the following:

  Text - Creates text to annotate a graphic.

  Line - Creates lines to use as boundaries, phase lines, or routes.

  Area - Creates polygons to use as designated areas.

  Minefield Marker - Creates markers for minefields and breach lanes.

  Point - Creates single vertex graphics to use as designated points.

  Minefield - Creates minefields that can be simulated.

  Unit - Creates military ground vehicles, air vehicles, and dismounted infantry.

HHour - Controls a unit's mission by setting a specific date and time for executing the various phases of its mission.

User Preferences - Configures the SAFStation's default measurement units.

Plan View Display (PVD) Controls - Configures the map display (select which terrain features to show and how to display the vehicle icons).

Stealth Control - Controls the three-dimensional Stealth vehicle when there is one on the network.

Artillery - Creates and controls artillery barrages.

Fire Support - Assigns and executes fire missions for artillery vehicles.

Terrain Tools - Presents a picture of specified map terrain showing visibility (from terrain locations or between vehicles) and a cross-section elevation display.

Rules of Engagement - Sets the firing parameters for units.

Delete - Removes graphics and units from the map and the simulation.

Overlay Editor - Creates, configures, and deletes overlays.

Environment Editor - Accesses an editor for setting environmental parameters.

Map Buttons let you adjust the map view and obtain information about selected vehicles or terrain locations. These buttons are marked with icons, and are referred to in this document as:

Zoom - Changes the map scale and enlarges the viewing area by zooming in or out around a location.

Pan - Changes the map viewing area while remaining in the same scale.

Info - Obtains data about a vehicle or a terrain location.

Environment - Obtains environmental data about a location.

- Icon Strip - This column, immediately to the right of the Button Column, contains military icons for units that the SAFstation controls. These icons act as buttons that allow you to select a unit for performing operations or immediate interventions. These icon buttons let you interrupt or change the unit's currently executing mission.
- Map - The map uses most of the color screen area. It lets you create scenarios and monitor simulated battles. Its two-dimensional terrain view represents real world locations, showing gridlines, roads, water, powerlines, pipelines, railroads, political boundaries, trees, contour lines, and buildings. The current map scale is displayed in the upper right corner. If the message "Redrawing Map. Please Wait." appears, wait until the message disappears before issuing further commands.
- Map Help - This line appears just below the Map. It identifies the currently selected Map Button and provides prompts for manipulating the map view using the middle and right mouse buttons.
- Editor Help appears below the Map Help or below the Editor Area when the Editor Area is displayed. There are three levels of Editor Help:

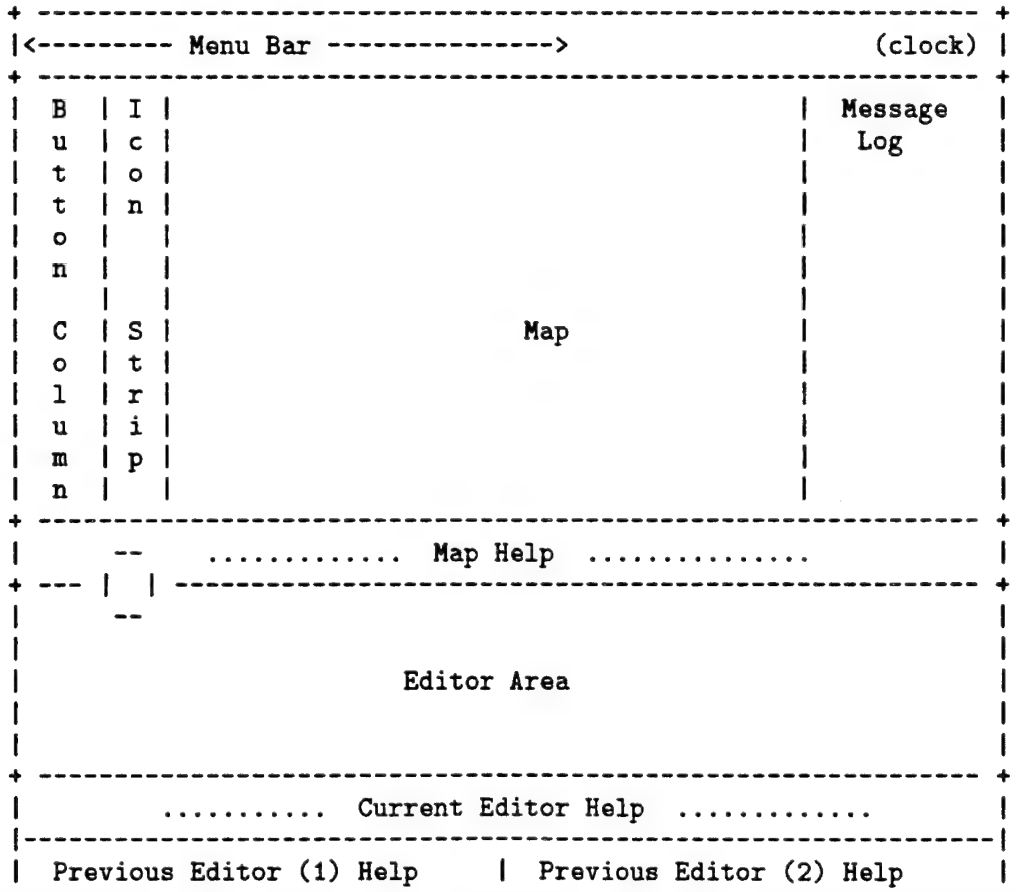
Current Editor Help - This line appears just below the Map Help. It is a help message telling you what the current editor expects.

Previous Editor (1) - This line appears below the Current Editor Help on the left side of the screen. It identifies the editor that becomes active when work in the current editor is completed.

Previous Editor (2) - This line appears below the Current Editor Help on the right side of the screen. It identifies the editor that becomes active when work in both the Current Editor and Previous Editor (1) is completed.

You can use toggle commands (accessed by clicking the Special command in the Menu Bar) to make the Editor Area and the Message Log appear. To display the Editor Area: select the **Show Editor** toggle feature. To display the Message Log: select the **Show Messages** toggle feature.

The following figure shows the layout of the SAFstation screen when both the Editor Area and Message Log are displayed.



The Editor Area, located beneath the Map Help area, displays the Editor menus. This area displays only when you: (1) select one of the Editor Buttons, or (2) select the **Show Editor** toggle feature (via the Special command in the Menu Bar).

To change the size of the Editor Area, drag/left on the small grey box, located on the upper left boundary of the Editor Area. Note: The Editor Area obscures part of the map, so you may want to use the **Show Editor** toggle feature to hide it at times.

The Message Log, located down the right side of the screen, captures simulated radio messages and commands you issue to your ModSAF forces. (The Message Log data can be saved to a file.) The Message Log displays only when you select the **Show Editor** toggle feature (via the Special command in the Menu Bar).

3.2 Using the Mouse

You can give commands to the SAFstation by moving the mouse pointer to the desired position on the screen and then clicking one of the three mouse buttons. In this document, "click/Middle" means click the middle mouse button; "click/Right" means click the right mouse button. Since the left button is used most often, click without a button choice means click the left mouse button. "Hold/Left" means "press and hold down the left mouse button". For example, "Hold/Left on an object in the Map" means to press and hold down the left mouse button while the mouse pointer is positioned on an object in the Map.

To perform certain functions, you must "drag" the mouse. This requires that you depress the button while moving the mouse. This is done, for example, when an area of the Map is outlined for the purpose of zooming in on that area. In this document, "Drag/Middle" means "move the mouse while you press the middle mouse button."

When you select a particular item within an editor, only that type of item is responsive to the mouse. The mouse-sensitive items are indicated by a rectangle or circle outline. Note: Objects in the Map are fully sensitive; you can select a route by clicking any place on it not just on its vertices.

3.3 Working with the Menu Components

Many commands and options that you request through the SAFstation are entered via the pulldown menus, editor displays, and pop-up windows. These items use components such as Text, Lists, Units (speed, distance), Dials, Angles, Toggles, Meters, and Scroll Bars. See Appendix A [Menu Component Operations], page 141, for extensive directions for working with these menu components.

3.3.1 Selecting Pulldown Menus

To access a pulldown menu, click on a menu name in the Menu Bar. The pulldown menu shows a number of alternative commands or options that you can select. To clear the screen of a menu without selecting one of the choices, click elsewhere on the display (such as in the Map).

3.3.2 Using the Editor Displays

Editor displays let you insert and alter parameter values. Clicking on a setting or entering data in an input box tells the system to set a parameter. Clicking on a button executes the action described by the button's label. A button, setting, or input box is outlined in red to show that it has the "system focus " (i.e., it is the input that the system is currently expecting). To move the focus to a particular value, click on that value. To advance the focus to the next value, press the TAB key. Use Shift-TAB to move the focus backwards to a previous focus.

3.3.3 Using the Pop-up Windows

Pop-up window displays are not confined to the Editor Area; they appear at a pre-determined location. You can, however, move them to another part of the screen. To move them, drag/Left on the label at the top of the display. You can enlarge or shrink the rectangular area that holds the pop-up display. To change the size of a display, move the mouse pointer to one of its corners. The mouse pointer changes from an arrow to a right angle symbol. When the right angle symbol is on the screen, drag/Left away from the display to enlarge or drag/Left toward the center of the display to shrink. A pop-up display will appear on the screen until you deliberately dismiss it by clicking on an appropriately labeled exit button (`OK`, `Cancel`, or `Done`).

3.4 Using the Help Messages

There are two help areas: Map Help and Editor Help:

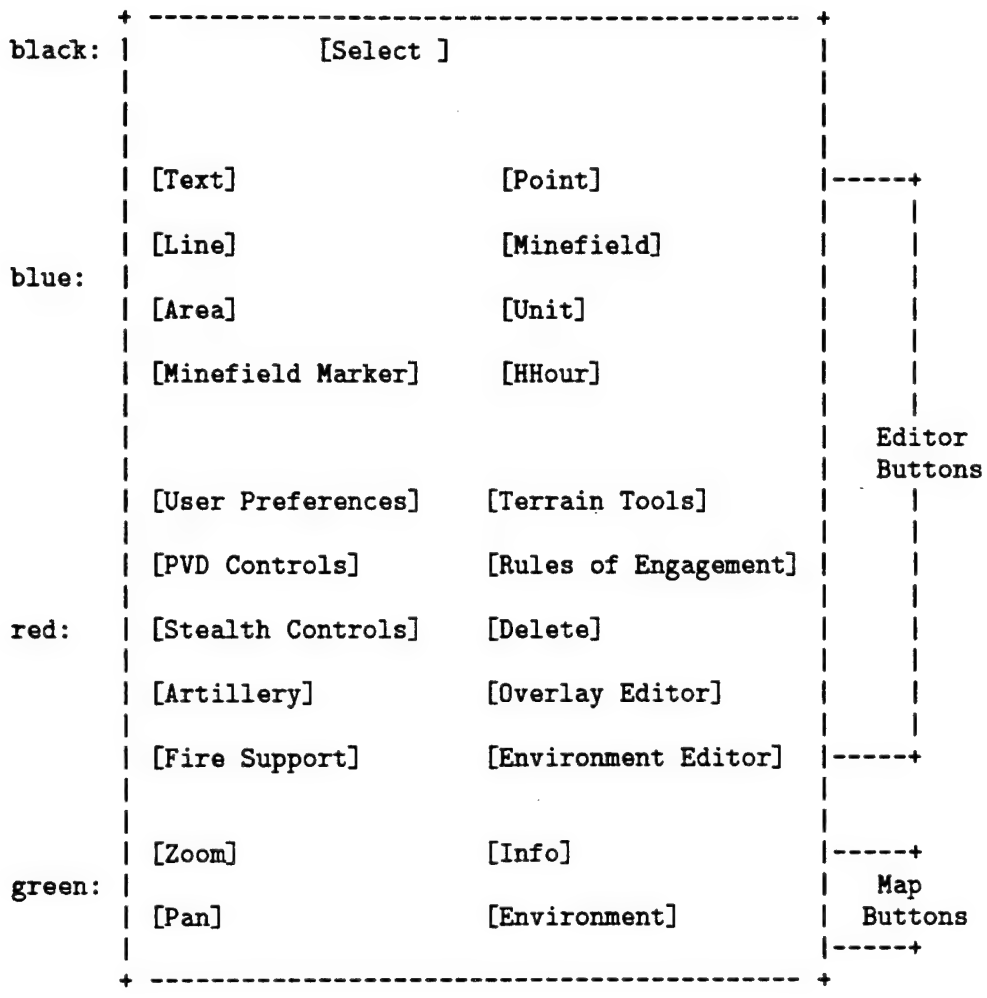
- Map Help appears just below the Map to identify the currently selected Map button and to provide directions for using the mouse buttons.
- Editor Help appears below the Editor Area when it is displayed or below the Map Help when the Editor Area is hidden. There are three levels of Editor Help: Current Editor, Previous Editor (1), and Previous Editor (2). Current Help supplies a help message to tell you what the current editor expects you to do. Previous Editor (1) Help, appearing below the Current Editor Help on the left, identifies the editor that will become active when work in the current editor is completed. Previous Editor (2) Help, appearing below the Current Editor Help on the right, identifies the editor that will become active when work in both the Current Editor and Previous Editor (1) is completed. The Previous Editor help lines are useful because certain editor menus need to be interrupted temporarily by other editors in order to complete a task.

Whenever you select another Editor button before exiting the current editor, the SAFstation changes to display the new editor. This signals a transition to a new editor mode, so the interrupted mode slides down and its help line displays with a gray background in the Previous Editor (1) Help line.

For example, this can occur when you select the Line button to create a route while setting up a movement task. The SAFstation program knows that the movement task editor needs to be interrupted, rather than exited, so that a route can be supplied. A message in the Current Editor Help line appears with the editor change notifying you of what the system now needs.

3.5 Using the Button Column

Three types of buttons are located in the Button Column on the left side of the screen: the black Select button is at the top of the column, red and blue Editor buttons are beneath the Select button, and the green Map buttons are at the bottom. The following figure identifies the buttons that appear in the Button Column.



When you select a button (using the mouse left button), you stay in its mode until you select another button. You always perform operations using the left button, except for Map mode operations which require the use of the middle and right mouse buttons.

The **Select** button is marked with an arrow. Use this button to place the SAFstation in Selection mode where you can select objects from the Map for editing. You can also use this button to change modes from one Editor button to another.

Use the **Editor** buttons to access various editor menus that appear in the Editor Area of the screen. These buttons are the primary means for setting up, running, and observing a simulation exercise. In addition, some of the menus allow you to configure the Map (which is also referred to as the PVD). The Editor buttons are:

- **Text** - (blue, labeled with letters A-F) lets you place text messages and labels on the Map. See Section 5.5 [Creating Text], page 42.
- **Line** - (blue, labeled with a military line symbol) Lets you create or edit line graphics on the Map. These lines can be vehicle routes or various types of military graphics: fronts, berms, anti-tank ditches, wire, etc. See Section 5.2 [Creating a Line], page 39.
- **Area** - (blue, labeled with a military area symbol) lets you create or edit area graphics on the Map (fortified areas, assault objectives, staging areas, etc.). See Section 5.4 [Creating an Area], page 41.
- **Minefield Marker** - (blue, labeled with a flag symbol) lets you create or edit marker graphics on the Map (minefield perimeter or breach lane markers). See Section 5.3 [Creating a Minefield Marker], page 41.
- **Point** - (blue, labeled with a military point symbol) Lets you create or edit military point graphics: target reference points, contact points, control measures, fortifications, etc. See Section 5.1 [Creating a Point], page 37.
- **Minefield** - (blue, labeled with a rectangle with a row of dots inside) Lets you create or edit anti-tank and anti-personnel minefields. See Section 8.2 [Minefield Tool], page 80.
- **Unit** - (blue, labeled with a tank) Lets you create and configure units of ground vehicles, air vehicles, and dismounted infantry. Note: Since the battlemaster is responsible for setting up an exercise, this button is enabled at Battlemaster mode. It is purposely not enabled at the Operator and Commander privilege levels to prevent the illegal addition of forces. See Section 6.1 [Creating a Unit], page 48.
- **HHour** - (blue, labeled with a clock) Lets you designate a specific date and time to begin a mission phase. See Section 7.9 [Setting HHour], page 74.
- **User Preferences** - (red, labeled with four small icons representing the four branches of the Armed Forces) Lets you configure the default measurement units used in the simulation exercise (coordinate system, speed, angles, distances, altitudes, fuel). This menu also lets you determine how to edit lines (whole or part) and which map scales are used for zooming. Finally, this menu lets you create map scroll bars. See Section 10.1 [Set User Preferences], page 95.
- **PVD Controls** - (red, labeled with a map representation) Allows you to configure the Map display. This includes choosing which terrain features to show, setting the size and style of the vehicle icons, choosing the hypsometry and map notation methods, and selecting the Map update rate. See Section 10.2 [Set Screen Display Options], page 96.
- **Stealth Control** - (red, labeled with a hollow arrow, pointing right) Allows you to control the Stealth vehicle teleportation and sets its attach modes. See Section 10.3 [Control the Stealth Vehicle], page 98.
- **Artillery** - (red, labeled with a mouse attached to a square around a dot) Lets you place indirect fire (mortars, artillery, rockets) on the battlefield without requiring an artillery vehicle. See Section 8.1 [Artillery Tool], page 79.

- **Fire Support** - (red, labeled with a military artillery battalion symbol) Lets you (as unit Commander) designate enemy targets and call down artillery fire or artillery-delivered minefields in support of your unit. See Section 8.3 [Fire Support Tool], page 82.
- **Terrain Tools** - (red, labeled with a compass dividers) Lets you obtain "on the ground" information about terrain locations. This information includes a graphic cross-section of the ground, visibility from a single vehicle (including tree blockage), and intervisibility between vehicles or points on the ground. See Section 4.10 [Terrain Tools], page 31.
- **Rules of Engagement** - (red, labeled with an O and X) Lets you configure or edit a unit's rules of engagement parameters (how the unit behaves when it makes contact with the enemy). These parameters include fire permission/hold fire, firing type, and firing coordination within the unit. See Section 6.3 [Setting Rules of Engagement], page 51.
- **Delete** - (red, labeled with scissors) Lets you select and delete objects from the Map, removing them from the simulation exercise. See see Section 5.6 [Deleting a Graphic], page 44 and see Section 6.2 [Deleting a Unit], page 50.
- **Overlay Editor** - (red, labeled with staggered squares) Lets you select the overlays to show on the SAFstation. This menu also lets you create, delete, rename, and edit overlays. See Section 10.4 [Edit an Overlay], page 99.
- **Environment Editor** - (red, labeled with a thermometer) Lets you select environmental parameters. Note: You can ignore this button for normal ModSAF operations. See Section 11.8 [Environmental Extensions], page 108.

Editor buttons place the SAFstation in a mode that can be interrupted, superseded by another mode, and then resumed when the interruptive mode is completed. Each time you select a new editor mode, it is placed on top of the current mode. When the current mode is done, the system returns back to the previous mode (i.e., the one that was active before you selected the new one).

Map buttons, such as zoom, data, and pan, are available on demand. The map buttons place the system in Map modes that can replace each other; they do not interrupt and stack. The SAFstation remains in one map mode until you select another. The name of the current map mode, and the functions of the middle and right buttons are shown in a help window that appears beneath the Map. The map buttons and directions for use are:

- **Zoom** - (green, labeled with arrows pointing in to a center point):

  ```
  Click/Middle zooms in; Click/Right zooms out
  Drag/Middle sets a screen area on which to to zoom in
  ```

- **Pan** - (green, labeled with a viewport):

  ```
  Click/Middle centers the Map around a selected terrain point
  Drag/Right moves viewport over a whole terrain grid
  ```

- **Info** - (green, labeled with a question mark):

  Hold/Middle on a vehicle in the Map describes it (vehicle ID, marking, type, location, speed)

  Hold/Middle on a point in the Map describes the location (terrain grade, soil type, location, altitude above sea level)

- **Environment** - (green, labeled with a thermometer):

  Hold/Middle on map for environmental information (terrain coordinates, temperature, humidity, and wind speed).

4 The Tactical Map View

The Map displays a two-dimensional view (plan view display or PVD) of the battlefield. In addition to terrain features, vehicle and unit icons, and battlefield geometry (labels, points, lines, areas, routes), it also displays the following battlefield events:

- An artillery round (indirect fire) detonating on the simulated battlefield. This appears as a large hollow purple star.
- A vehicle hitting a mine. This appears as a large hollow yellow star.
- A direct fire shot that hits its target. This appears as a yellow line from the firer to the target. A solid yellow circle on one endpoint indicates the target.
- A direct fire shot that misses. This appears as a grey line from the firer to the hit location. A solid grey circle on one endpoint indicates where the shot lands.
- Two vehicles involved in a collision. This appears as a solid red star.
- A vehicle with a catastrophic failure. This appears as a black vehicle.
- A vehicle with a known mobility failure. This appears as a vehicle with a bent hull.
- A vehicle with a known firepower failure. This appears as a vehicle with a bent gun tube.

Sometimes the portion of terrain displayed in the Map is not the area of interest. The scale, pan, zoom, scroll, and information functions let you change the Map view and obtain data about a location or vehicle.

There are two SAFstation view modes: **Omniscient View** and **Commander View**. Omniscient View displays all vehicles in the exercise regardless of their alignment, commanding SAFstation, or location. Commander View limits the display to be consistent with the SAFstation's alignment (friendly, enemy, or both) and the list of units it commands. View mode is based on the current privilege selected from the Menu Bar. Omniscient View is used with Battlemaster and SysOp privilege. Commander View is used with the Operator and Commander privilege.

When you select a unit after it has been tasked, the unit's situation awareness icons automatically appear on the Map to indicate the enemy units that your selected unit is aware of. These icons appear as dashed rectangular outlines colored white. These icons are for display purposes; you cannot click on them to command units.

4.1 Changing the Scale

When the scale is set to 1:100,000, 1cm on the screen represents 1km on the terrain. As you move to a scale of 1:5,000, less of the database appears, but what does appear is magnified. Higher magnifications can be obtained by repeated "zoom in" operations.

A current scale indicator is provided above the North-pointing arrow in the upper-right corner of the Map. The current scale can be a standard or a non-standard scale, depending on the Standard Scale setting of the PVD Controls menu in the Editor Area.

To change the scale:

1. Click **Map Scale** in the Menu Bar. A pulldown menu appears listing possible scales (such as 1:1,500,000, 1:1,000,000, 1:500,000, 1:250,000, 1:100,000 1:50,000, 1:25,000, 1:10,000, 1:5,000 1:2,500 1:1,000, 1:500, 1:250). The option of undoing the last zoom or pan operation is also available.
2. Click on a scale. A recessed toggle box appears with the selected scale. The Map is redrawn to the selected scale.
3. Click **Undo last Zoom/Pan** to revert to a Map display prior to the most recent zoom, pan, or scale operation. An alternate way to issue the command using the keyboard is by using ALT <Z> (type the key labeled "ALT" and then type "Z").

4.2 Panning to a New Map Center

To move to a new map center:

1. Click the **Pan** button (the second green map button on the left).
2. There are two ways to pan the Map:
   - Click/Middle on a location you want as Map center. The Map shifts to position that location in the center.
   - Hold/Right to see a screen area box (a viewport). Drag/Right to move the viewport to a new location (you will see a grid display to help orient you). Release the right button when the viewport is on the area you want to display.

4.3 Zooming In and Out

To change the Map size:

1. Click the **Zoom** button (the first green map button on the left). The Map Help message explains that when doing a zoom operation, Click/Middle zooms in, Click/Right zooms out, and Drag/Middle goes to a scale encompassing the dragged area.
2. The zoom operations use Click/Middle, Click/Right, and Drag/Middle as explained below:
   - Click/Middle when the pointer is on the location you want as the center of the Map. The terrain in the Map shifts to place the selected location at the center and the Map scale is *decreased* one level to magnify the terrain.
   - Click/Right when the pointer is on the location you want as the center of the Map. The terrain in the Map shifts to place the selected location at the center and the Map scale is *increased* one level to display more terrain.
   - Drag/Middle to mark a rectangular area of terrain for magnification. When the pointer is placed at a location in the Map, it specifies one corner of the rectangle. press and hold the middle button to drag the pointer to another position to specify the opposite corner. When you have dragged enough to set the corner, release the middle button. The Map shifts to place the area center at the Map center. The Map scale automatically adjusts to either a standard or non-standard scale allowing the selected area to appear on the screen. Note; When "Zoom Any Scale" is the User preferences default, zooming in around an area displays the selected area without forcing the use of one of the standard Map scales. See Section 10.1 [Set User Preferences], page 95.

4.4 Scrolling the Map

To navigate the Map with horizontal and vertical scroll bars:

1. Set the user preference options to display scroll bars. See Section 10.1 [Set User Preferences], page 95.
2. Hold/Left on the scroll indicator (a small square) inside the scroll bar. While holding, move the mouse. As the indicator moves, the Map scrolls. (You can also click on the arrow that appears at either end of the scroll bar.)

4.5 Obtaining Terrain Information

To see the information message:

1. Click the **Info** button in the Button Column (the green button labeled with a question mark). The Map Help message explains that when doing a data operation you can select either a vehicle or a terrain location.
2. Hold/Middle on either a vehicle or a terrain location. Vehicle or terrain data displays on the Map Help line depending on what you select. The vehicle information gives vehicle ID, marking, type, location, and speed. The terrain information gives grade, soil type, location, and altitude above sea level.
3. Release the middle button to remove the information message.

4.6 Obtaining Environment Information

To see the environment information:

1. Click the **Environment** button in the Button Column (the green button labeled with a thermometer). The Map Help message explains that when doing this data operation you should select a terrain location.
2. Hold/Middle on a terrain location. The environmental data for that terrain location displays on the Map Help line. The environment information gives coordinates, temperature, humidity, and wind speed.
3. Release the middle button to remove the message.

4.7 Altering Terrain Feature Displays

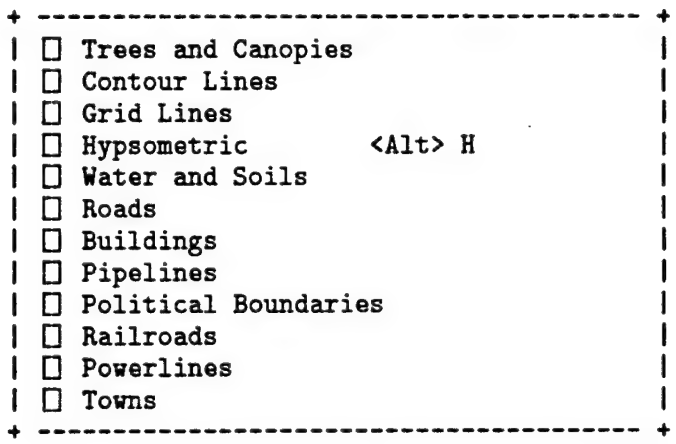
Terrain features include: UTM grid lines, water, roads, trees, buildings, powerlines, pipelines, towns, political boundaries, and contour lines (both major and minor). Display of a terrain feature is optional.

Each terrain feature is color-coded. The color codes are: blue (water), red (roads), green (trees), blue-green (pipelines), mustard (political boundaries), brown (major contour lines), beige (minor contour lines), and black (gridlines, buildings, powerlines, and railroads).

The ModSAF system determines the intervals for contour lines by reading data stored in a file named features.rdr. This file allows the system to set different intervals for each available terrain database or to use default levels. You can adjust the intervals by changing the data in the file.

To determine the details of the Map display:

1. Click **Map Features** in the Menu Bar. A menu containing feature names (color-coded to serve as a Map legend) appears. The menu is similar to the following:



2. Click on a terrain feature's toggle box to change that feature's display status. If the setting was off, it changes to on and the toggle box and the terrain feature display. If the setting was on, it changes to off and the toggle box and terrain feature disappear.

   Note: A change in display status does not change the terrain database. The simulation always attempts to create a ground route that bypasses unfordable water with a bridge or shallow (light blue) water regardless of the display status of water.

4.8 Changing Hypsometric Display

To show elevation above sea level:

1. Click **Map Features** in the Menu Bar.
2. Click **Hypsometric** to change the display status of hypsometric mapping. If the setting was off, it changes to on and the mapping (of pattern by altitude) displays. An alternate way to change the display status of the hypsometric mapping is via ALT <H> (type the key labeled "ALT" and then type "H").

4.9 Setting the View Mode

There are two view modes: Omniscient and Commander. You set the view mode when you set the privilege level. When the SAFstation privilege is high (Battlemaster), the SAFstation defaults to Omniscient View where all vehicles are displayed. When the SAFstation privilege is low (Commander), the SAFstation defaults to Commander View. In Commander View a vehicle is displayed ONLY if it meets at least one of the following conditions:

- It is a vehicle that this SAFstation is commanding.
- It is a vehicle whose alignment (friendly or enemy) matches the alignment selected with the **Local Force** menu in the Menu Bar.
- It has been "detected" by one of the vehicles this SAFstation is commanding.

The SAFstation alignment (friendly, enemy, or both) is set with the **Local Force** menu in the Menu Bar. However, it can only be set while the SAFstation is in SysOp or Battlemaster privilege.

To set view mode:

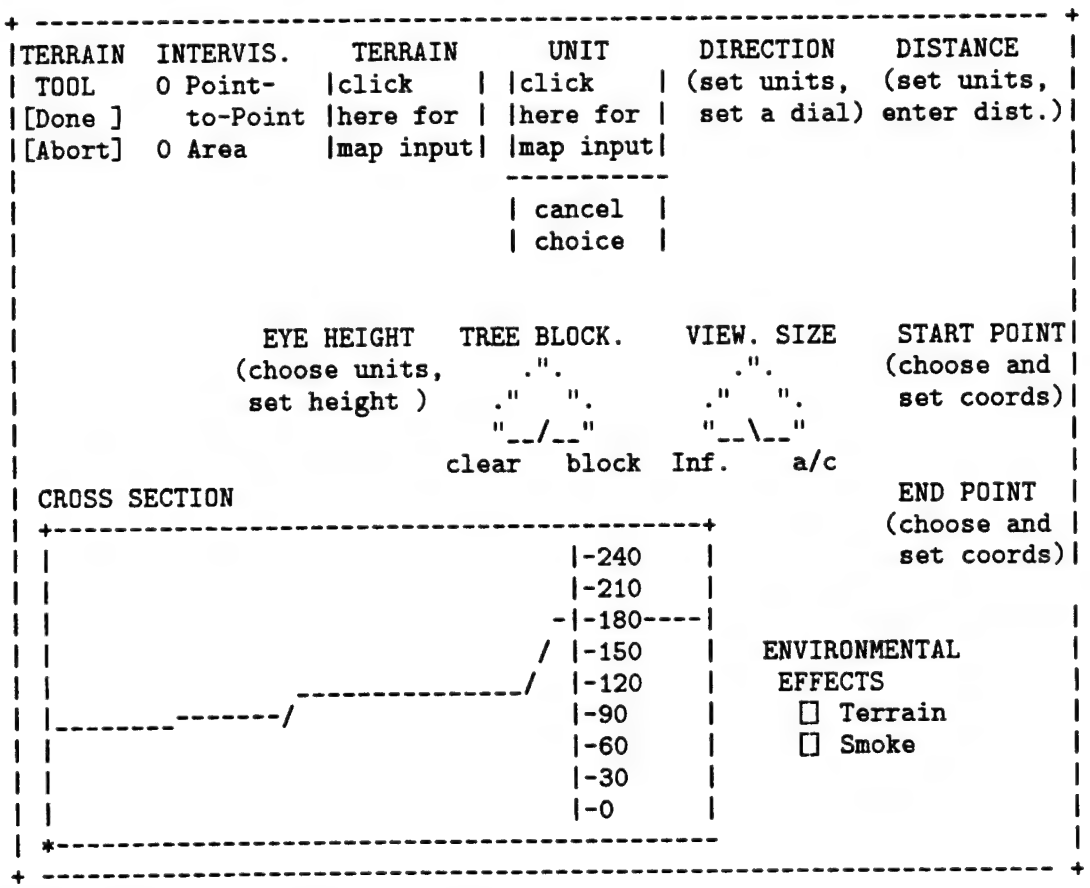
1. Click **Battlemaster** in the Privilege pulldown menu to set the SAFstation to Omniscient View. (When the SAFstation is in Battlemaster privilege, the SAFstation alignment can be set using the **Local Force** menu on the Menu Bar.)
2. Click **Commander** in the Privilege pulldown menu to set the SAFstation to Commander View. In this viewing mode, the Map display is constrained for consistency with the SAFstation's alignment and list of commanded units.

4.10 Using Terrain Tools

Terrain tools let you view a three-dimensional battlefield terrain. When you click the Terrain Tools button, the Terrain Tools editor appears in the Editor Area. You can then ask ModSAF to display intervisibility between points, visibility in an area (including tree blockage), intervisibility around a vehicle, or intervisibility between vehicles. By knowing the terrain elevation, the system can determine the visibility at each point. In addition, an elevation cross section view of the terrain can be obtained.

To use the terrain tool:

1. Click the Terrain Tools button (second column, first red button). This button is labeled with a compass. A menu similar to the following appears in the Editor Area.



2. To perform *terrain point-to-point intervisibility*:
   1. Click `Point to Point`.
   2. Click on the Terrain `Click Here for Map Input` button.
   3. Click and drag in the Map between the desired points. A visibility line is drawn on the

Map showing green for fully visible, green-to-black dithered for partially visible, and black for blocked. The line also contains tick marks at the same interval as the current grid on the screen. The cross section of that line is also calculated, as well as the distance between and the coordinates of the starting and ending points.

3. To perform *terrain area intervisibility*:
   1. Click **Area**.
   2. Click on the Terrain **Click Here for Map Input** button.
   3. Click and drag in the Map. A visibility circle, from the selected point out to the dragged radius, is drawn to represent what a viewer (with 360 degree vision) could see when placed on the ground at the center of the circle. The circle shows clear for fully visible, grey dithered for partially visible, and black for blocked areas. In other words, a viewer would be able to see objects on the clear area, and parts of objects on the shades-of-gray areas. A visibility circle containing mostly small black squares with a few clear squares in the middle (around the the viewer's location point) could indicate that a viewer was in a valley with visibility in only some adjacent areas. A black square appearing in the middle of a clear area could indicate a steep elevation change, such as a depression, which the viewer could see behind and around but not in.
4. To perform *vehicle point-to-point intervisibility*:
   1. Click **Point to Point**.
   2. Click on the Unit **Click Here for Map Input** button.
   3. Click on a vehicle in the Map. Lines from the selected vehicle to other vehicles along with visibility percentages are drawn. See Section 6.1 [Creating a Unit], page 48.
5. To perform *vehicle area intervisibility*:
   1. Click **Area**.
   2. Click on the Unit **Click Here for Map Input** button.
   3. Click on a vehicle in the Map. A visibility circle from the selected vehicle out to a radius of 3500 meters is drawn. The circle shows clear for fully visible, clear-to-black dithered for partially visible, and black for blocked.
6. Set parameters, if necessary:
   - The ModSAF intervisibility model uses the height of the viewer for input. A default Eye Height is provided. If necessary, change the value by entering a new height.
   - Since the ModSAF intervisibility software contains a light transmittance model which can be used to model the cumulative effect of intervening trees, the editor does provide a Tree Blockage dial. A default is provided. If necessary, change the value by moving the dial pointer.
   - Since the ModSAF intervisibility model uses both target width and height (relative to the viewer), the editor provides a a Viewing Size dial and a median default. If necessary, change the value by moving the pointer in the dial.

- The Environmental Effects setting tells the ModSAF intervisibility model to use or ignore the named environmental effect.

7. Select an exit option:
   - Click **Abort** if you make a mistake and want to exit without performing any operations.
   - Click **Done** whenever you are finished using the Terrain Tool editor.

5 Graphic Operations

Battlefield geometry graphics (including routes) can be placed in the Map to define mission parameters and show the various phases of a battle situation. These graphics are created by using the **Point**, **Line**, **Area** and **Text** buttons in the Button Column. Graphics are deleted using the **Delete** button. See Section 3.5 [Using the Button Column], page 19.

When you click a graphic button, the editor for that graphic type appears in the Editor Area. The editor display has a "Done" button which is not sensitive until you specify a location. Locations are set by clicking the left button in the Map. No graphic vertices are placed with the middle or right button. If you make a mistake placing a vertex location, you can move it.

The ModSAF system requires that each graphic belong to an overlay. You associate a graphic with an overlay by setting its overlay name. You can specify an overlay name by:

- Doing nothing to accept the name that appears in the overlay name box.
- Pressing **Press for Other Overlays** and selecting another overlay name from a list.
- Pressing **Create New Overlay** and typing a new name in the overlay name box.
- Clicking in the overlay name box. A blinking insert cursor (small black bar) appears. Use the keyboard to delete and enter a new overlay name.

An overlay has a color and force (friendly, enemy, or all) parameter to specify defaults for any graphics placed on the overlay. You can change the value of these parameters by selecting another value from a list.

When you select a graphic from the Map, its editor displays in the Editor Area. The editor has editable options (color, line style, overlay) which apply to the currently selected object. In the Editor Area, a field that is waiting for your data input is outlined in red. To advance to the next field, press the TAB key or click the next parameter area. You can return to the previous field by pressing Shift-TAB or by clicking the field.

Some editor parameters are only used for display purposes. These parameters include:

Color - When you select a color, the graphic is drawn using that color rather than the default color of its overlay.

Dashed - When the toggle setting is ON (recessed), the graphic appears dashed rather than solid when it is drawn on the Map. Military personnel use a dashed graphic to represent information that is uncertain.

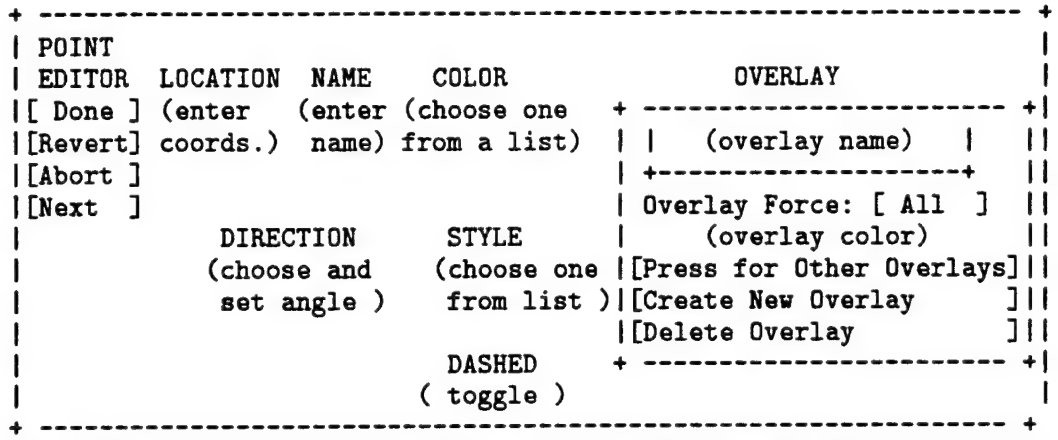
Style - When you select a style, the graphic is displayed so that its appearance corresponds to standard military graphics.

5.1 Creating a Point

You can use a point graphic to specify a destination location, a target reference point, or a contact point.

To create a point:

1. Click the Point button (second column, first blue button). A display similar to the following appears in the Editor Area. The Current Editor Help line below the Editor Area prompts you for a location.



2. Click in the Map to set the point's location. If you make a mistake placing the point, click on another position to move it. You can also change the location by entering coordinates in the Location box. To change the coordinate type (X/Y, Lat/Long, UTM), click one of the Location Unit toggles. Note: Usually you do not need to change the coordinate type.
3. When necessary, change the values of any settings:
   - To change the point style or color value, hold/Left on the current value and select a new value from the displayed list.
   - To change the Dashed setting, click its toggle box.
   - To change the direction type (degrees, Mils, compass heading), click one of the Direction Unit toggles. To change the direction heading, hold/Left on the angle arrow in the dial and drag/Left to move the arrow to a new setting. (Another way to change the direction setting is to click in the text of the current value, press the SPACE BAR to delete, and enter a new value.)
   - To provide a point name, click in the Name box and enter the name. Note: The name appears as a label for the point graphic.
   - If necessary, supply an overlay name.
4. Select a button from the upper left corner:

- Click **Done** to create the point and exit the editor.
- Click **Next** to create the point and remain in the editor to create another point.
- Click **Revert** to remove any new settings without exiting the editor.
- Click **Abort** to ignore inserted data and exit from the editor.

5.2 Creating a Line

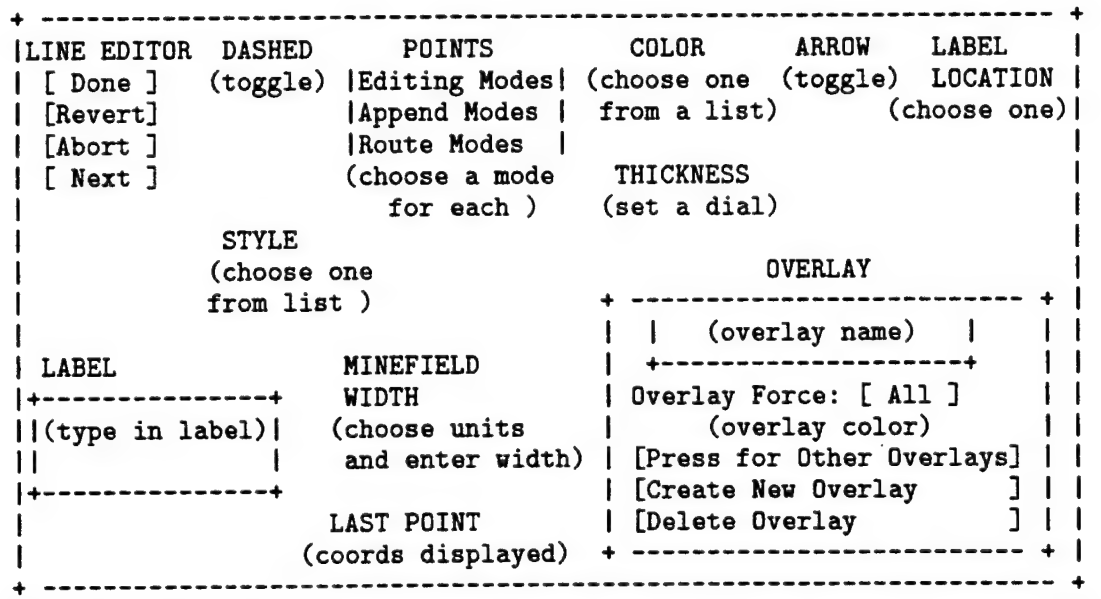
Use a line graphic for routes, boundaries, and phase lines. A route can contain both road and cross-country vertices.

When creating a route for air vehicles, remember that an air vehicle can not make the sharp turns that a ground vehicle can. If a route for air vehicles has turns that are too sharp or too closely placed, it might look like the vehicle is not following the route. Actually the vehicle is attempting to fly to each point on the route as best it can while satisfying the requirements of its flight dynamics model.

The location of the last point in a line graphic is displayed in the Line editor. This is for display only (it is not sensitive).

To create a line graphic:

1. Click the Line button (first column, second blue button). A display similar to the following appears in the Editor Area.



2. Click on the Map to position the vertex points for the line. A line of the appropriate type appears, connecting the vertex locations. (If you want to position a road point rather than a cross-country point, click on the "Use Roads" toggle box under Route Modes in the Points field. The road segments of the Map can then become "mouse sensitive". To position a road point, position the mouse pointer on the road. A segment of the road will highlight with a rectangular outline box. Clicking on that highlighted segment positions the road point at the

location of the click.) Setting the line between two road points causes the route to stay on roads. Note: You can select a cross-country point even when the "Use Roads" toggle is ON since the toggle controls only the mouse sensitivity of road segments.

3. When necessary, change the values of any settings:

   - To change the setting on the Editing Modes, click on one of the toggle boxes. There are three line editing modes: Parts, Whole, or Delete. When you select a mode, directions appear in the Current Editor Help line. See Section 5.7 [Editing a Graphic], page 44.
   - To change the setting of the Append Modes, click on one of the toggle boxes. The "After" mode lets you extend a line by adding points to the end. The "Before" mode lets you extend a line by adding points to the beginning. Note: When the "Use Roads" toggle is ON, you can extend only using the "After" mode.
   - To change the Dashed setting, click its toggle box.
   - To change the line style or color, hold/Left on the current Style or Color value and then select a new value from the displayed list. Note: A line whose style is ATDitch(1) or ATDitch(2) is a special case since it creates a simulated barrier obstacle. Vehicles need to drive around the anti-tank ditch lines. In DIS protocol, an AVLB vehicle can place a bridge across an anti-tank ditch segment to permit vehicle crossing.
   - If you created a minefield line style, you can change its width by clicking in the Minefield Width input box and then doing a drag/Left on the Map to stretch a ruler value. (Another way to alter the value is to press the SPACEBAR to delete and then type a value.) Note: Minefields placed with the Line Editor are for display purposes only, they are not simulated.
   - To create a line with an arrow at the end, click **End** in the Arrow box.
   - To change the thickness of the line, move the indicator (pointer) inside the Thickness dial.
   - To enter a label for the line, click in the Label box and type a name. To change the placement of the label, click on the desired Label Location toggle.
   - If necessary, supply an overlay name.

4. Select a button from the upper left corner:

   - Click **Done** to create the line and exit the editor.
   - Click **Next** to create the line and remain in the editor to create another one.
   - Click **Revert** to remove settings you just entered without exiting from the editor.
   - Click **Abort** to ignore inserted data and exit from the editor.

5.3 Creating a Minefield Marker

You can use a minefield marker graphic to designate a minefield marker or a breached lane. Currently minefield markers can appear on the Map and on a three-dimensional Stealth view, but are not used in the simulation.

To create a minefield marker:

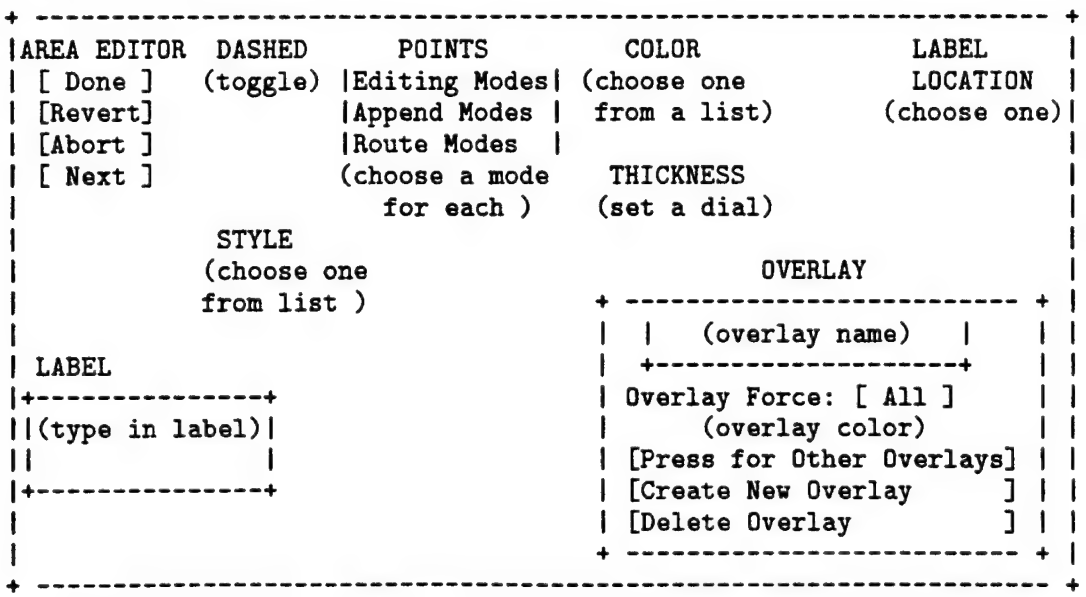
1. Click on the Minefield Marker button (first column, fourth blue button). This button is labeled with a flag.
2. You create and edit minefield markers and minefield breached lanes in the same way as lines. See Section 5.2 [Creating a Line], page 39.

5.4 Creating an Area

You can use an area graphic to designate an assembly area on the Map. An area graphic is similar to a multi-segment line except its first and last vertices are joined.

To create an area graphic:

1. Click on the Area button (first column, third blue button). A display similar to the following appears in the Editor Area.



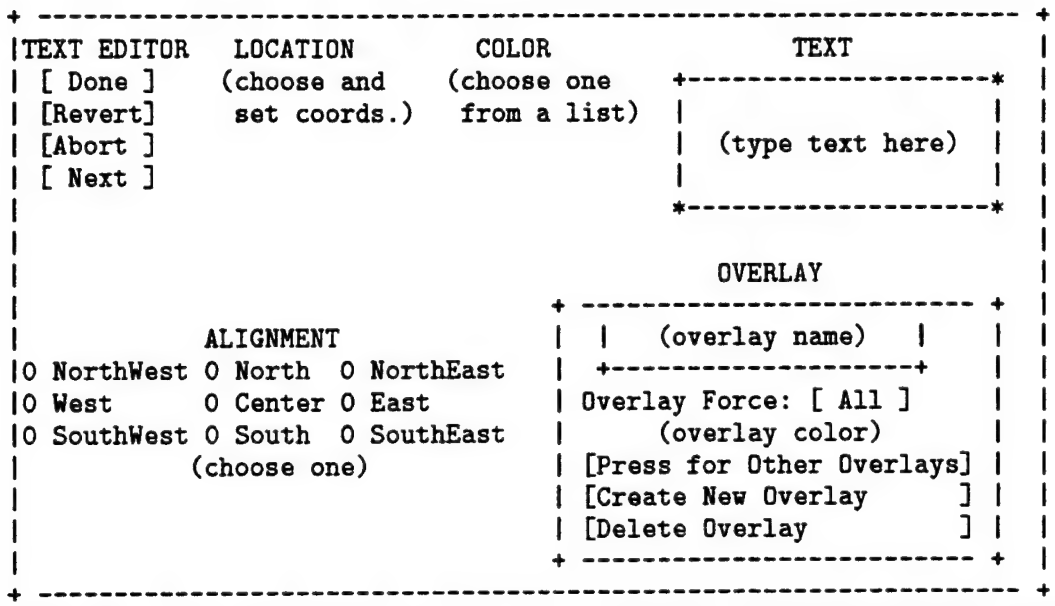
2. Click in the Map to position the vertex points for the area. Do not close the area since an area graphic has its first and last vertices automatically joined.
3. When necessary, change the values of any settings:
   - To change the setting on the Editing Modes, click one of the toggle boxes. There are three line editing modes: Parts, Whole, or Delete. When you select a mode, directions appear in the Current Mode Help line. See Section 5.7 [Editing a Graphic], page 44.
   - To change the setting of the Append Modes, click one of the toggle boxes. "After" mode lets you extend an area by adding vertices to the end. "Before" mode lets you extend an area by adding vertices to the beginning. Note: When the "Use Roads" toggle is ON, the "Before" mode is inactive.
   - To change the setting on the Route Modes, click its toggle box. The "Use Roads" option allows road segments to be "mouse sensitive" so that road points as well as cross-country points can be part of the area.
   - To change the Dashed setting, click its toggle box.
   - To change the area style or color, hold/Left on the current value and then select a new value from the displayed list.
   - To change the thickness setting of the area boundaries, move the indicator (pointer) in the Thickness dial.
   - To enter a label for the area, click in the Label box and type a name. To change the placement of the label, click the desired Label Location toggle.
   - If necessary, supply an overlay name.
4. Select a button from the upper left corner:
   - Click `Done` to create the area and exit.
   - Click `Next` to create the area and remain in the editor to create another area.
   - Click `Revert` to remove any new settings you just entered without exiting from the editor.
   - Click `Abort` to ignore inserted data and exit from the editor.

5.5 Creating Text

You can place text labels on the Map to identify objects or terrain features.

To create a text graphic:

1. Click the Text button (first column, first blue button). A display similar to the following appears in the Editor Area. The Current Editor Help line beneath the Editor Area reminds you to provide a location from the Map.



2. Click in the Map to set the location for the text. If you make a mistake setting the location, click on another position to move it. You can also change the location by entering coordinates in the Location box. To change the coordinate type (X/Y, Lat/Long, UTM), click one of the Location Unit toggles. Note: You do not usually need to change the coordinate type.
3. When necessary, change the values of any settings:
   - To change the text label's Alignment, click on one of the toggles. The alignment determines where the text will appear on the overlay relative to the location entered for the text. For example, a North alignment means that the text will appear directly above the location. The text always appears horizontal, regardless of the alignment setting.
   - Click in the Text box. A blinking insert cursor (small black bar) appears. Use the keyboard to enter the text.
   - If necessary, supply an overlay name or overlay color.
4. Select a button from the upper left corner:
   - Click **Done** to create the graphic. The text written in the box will appear at the selected location in the Map.
   - Click **Next** to create the text and remain in the editor to create another text graphic.
   - Click **Revert** to erase any inserted data without exiting from the Text editor.
   - Click **Abort** to ignore any placed text and exit from the Text editor.

5.6 Deleting a Graphic

To delete an object:

1. Click on the Delete button (second column, third red button). This button is labeled with scissors. A display similar to the following appears in the Editor Area.

```
+ ------------------------------------------------------------ +
|DELETE TOOL       OBJECT TO DELETE                            |
| [ Done ]     [Click Here for Map Input]                      |
| [Abort ]                                                     |
|                                                              |
+ ------------------------------------------------------------ +
```

2. To select an object from the Map, click on the button labeled `Click Here for Map Input` and then click in the Map to specify an object. Only objects that are valid deletion choices can be selected. A large red "X" appears on an object to mark it for deletion.
3. If you make a mistake, click the `Abort` button. You can also remove the "X" deletion mark by reclicking the object.
4. Click `Done` to perform the deletion of any objects marked for deletion.

5.7 Editing a Graphic

You can edit graphic objects once they are created. To do this, the object must be mouse-sensitive. When the pointer touches a mouse-sensitive object, the selection becoming enclosed in a rectangle or circle. This is referred to as "being highlighted with an outline".

If you want to edit road segments and vertices, enable the "Use Roads" toggle (under "Route Modes" in the Point field of the editor). This makes road segments and vertices sensitive to the mouse. (If you are only concerned with cross-country segments and vertices, the "Use Roads" toggle can be off.)

You edit a graphic by accessing its editor. To access these editors:

1. Click the Select button (marked with a black arrow) to place the SAFstation in Select mode.
2. Select the graphic by positioning the mouse pointer on its label, or on one of its vertices or segments.

5.7.1 Add a Vertex to a Line Segment

1. Set Editing Modes to **Parts** in the Points box of the editor. See Section 5.2 [Creating a Line], page 39. See Section 5.4 [Creating an Area], page 41.
2. Click on a segment in the Map. A new vertex point will be inserted on the segment at the location of the click.
3. Repeat adding vertices or click **Done**.

5.7.2 Extend a Line

1. Set Editing Modes to **Whole** or **Parts**. Set the Append Mode to **Before** to create a prefixed extension or to **After** to create a suffixed extension. Note: When the "Use Roads" toggle is ON, the "Before" mode is inactive, so you can extend a line using "After" mode only.
2. Click on the Map. Depending on the Append Mode setting, either the beginning or the end of the route will extend to the new point.
3. Perform another extension or click **Done**.

5.7.3 Move a Line or Area

Note: Since road point vertices must remain on a road, they can not be moved the way cross-country vertices can. Therefore, you should move a line or area only when the graphic contains no road points.

1. Set Editing Modes to **Whole** in the Points field of the Line or Area editor. See Section 5.2 [Creating a Line], page 39. See Section 5.4 [Creating an Area], page 41.
2. Hold/Left on a segment in the Map. An outline box appears around the segment. Drag/Left to move the graphic to a new location.
3. Perform another move or click **Done**.

5.7.4 Move a Vertex

1. Set Editing Modes to **Parts** in the Points field of the Line or Area editor.
2. Hold/Left on a vertex in the Map. An outline circle appears around the vertex. Drag/Left to move the vertex to a new location.
3. Perform another move or click **Done** in the menu.

5.7.5 Cutting a Vertex

When deleting a vertex in a line or area graphic that contains a road segment, begin the deletions at the last point of the graphic.

1. Set Editing Modes to **Delete** in the Points box of the Line or Area editor.
2. Click on a vertex to delete it.
3. Perform another deletion or click **Done**.

6 Unit Operations

You create ModSAF entities by clicking the Unit button (marked with a tank) to access the **Unit editor**. This button is active only in the Battlemaster and SysOp privilege levels. Note: The Unit editor has a "Done" button which is not active until you click in the Map to specify a location.

To perform operations on an existing ModSAF unit, click the Select button (black arrow) and then choose a vehicle or unit from the Map. When the **Unit Operations** editor appears in the Editor Area, you can assign operations to the unit. (Another way to perform operations on a unit is by using the **Immediate Interventions** menu available on the Icon Strip on the left side of the Map).

This chapter contains directions for creating units and assigning unit operations.

6.1 Creating a Unit

In addition to individual vehicles, ModSAF can simulate platoons, companys, and battalions of ground vehicles, batteries of artillery with modeling of Fire Direction Centers (FDCs), teams of dismounted infantry with anti-tank or air-defense missiles, flights of fixed-wing aircraft, and flights of rotary-wing aircraft. ModSAF also models specialized systems such as LOSAT, NLOS, Counter Battery Radar, Apache/Longbow, and Commanche, as well as special munitions such as STAFF, laser designated Hellfire missiles, and SADARM.

1. Click on the Unit button (second column, third blue button). A display similar to the example below appears in the Editor Area. The Current Editor Help line (beneath the Editor Area) reminds you to provide a location from the Map.

```
+ ------------------------------------------------------------------ +
|UNIT EDITOR  UNIT TYPE   FORMATION  DEFAULT CALL SIGN   LOCATION     |
| [ Done ]  (choose one  (choose one <Bn-Co-Plt-Veh>    (choose and   |
| [Revert]  from a list) from a list)  CALL SIGN        set coords.) |
| [Abort ]                           (type one in)                   |
| [ Next ]                                                           |
|              SIDE       SUB-FORMATION                              |
|             (friend or   (choose one                               |
|              enemy)       from a list)                             |
|                                                                    |
|                                                                    |
| DIRECTION    COMPETENCE  METHODOLOGY   FUEL AND MUNITIONS COMMANDER |
|(choose and  (set a dial) X Fundamental (choose fuel units, (set a  |
| set angle)               0 Soar         edit supplies)   SAFstation)|
|                          0 Samual                                  |
+ ------------------------------------------------------------------ +
```

2. Set a location for the unit by clicking in the Map. If you want to change the unit's location coordination type (X/Y, Lat/Long, UTM), click on one of the Location Unit toggles. To change the location coordinates, click in a coordinate box and then click in the Map. If you make a mistake placing the unit, just click on another position to move the location. (Another way to change the location is to type a new value in the Location box.)
3. When necessary, change the values of any settings:
   - To change the Unit Type, hold/Left on the current type and select a new type from the displayed list.
   - To change the unit's Formation or Sub-Formation, hold/Left on the current value and select a new formation from the displayed list.
   - To change the Side setting, click on the appropriate toggle box. Usually you do not need to do this since US and German units are "Friendly" and Russian units are "Enemy" by default. You could, however, create two vehicles of the same type (such as two M1 tanks) and assign one of them to the opposing side if you wanted them to engage.

- Direction determines which way the unit will be facing when it is created. To change the Direction measurement type (degrees, Mils, compass heading), click on one of the Direction Unit toggles. To change the direction, hold/Left while the pointer is on the arrow and then drag/Left to move the arrow to a new direction. (Another way to change the direction is to enter a new direction in the Direction value box.)
- To change the Competence parameter (used to model crew proficiency), click inside the semi-circle to move the indicator. As the indicator is moved to the left end of the scale, the competence decreases (the probability of hit decreases and the resulting wait before shooting time increases). As the indicator is moved to the right, competence increases.
- A company's default Call Sign will be 100A, a platoon's default Call Sign will be 100A1, and a vehicle's default Call Sign will be 100A11. 100A11 stands for battalion number 100, company A, platoon 1 and vehicle 1. To assign a different battalion number to the unit: click in the Battalion box and type a number. To assign a different company, platoon, or vehicle identifier: click on their respective button and select a different value from the displayed list. (Another way to assign a different marking to the unit is to click in the Call Sign box, erase the current label, and type a new one.)
- To change the Methodology setting, click on the appropriate toggle box. Most users will keep the Fundamental setting; Soar and Samual are only useful for some special and unique ModSAF applications.
- To change Fuel and Munitions supply levels, click the supply box you want to edit. Press the SPACEBAR on the keyboard to erase the current value, then type the new amount. Note: Entering U (for Unlimited) as the new amount means the entity will not deplete that resource.
- The Commander field gives command of a unit to the named SAFstation and its operator. This field permits locking to keep one SAFstation operator from being able to control another SAFstation operator's forces while the two SAFstations share the same PO database. To change the unit's Commander, hold/Left on **Press for List** and select a new machine from the displayed list. This change lets you transfer control of a unit from one SAFstation to another.

4. Select a button from the upper left corner:
   - Click **Done** to create the unit and exit the Unit editor. Note that for each unit you command, a corresponding unit symbol will appear in the Icon Strip. See Section 6.4 [Performing Immediate Interventions on a Unit], page 53.
   - Click **Next** to create the unit and remain in the editor to create another unit.
   - Click **Revert** to remove new settings you have just entered without exiting.
   - Click **Abort** to ignore any inserted data and exit.

6.2 Deleting a Unit

Use the Delete button (marked with scissors) in the Button Column to delete a unit. When deleting a unit, delete it at the level at which it was created. For example, to delete a platoon, be sure to show the unit as a platoon via the "Show As" command. See Section 5.6 [Deleting a Graphic], page 44.

6.3 Setting Rules of Engagement

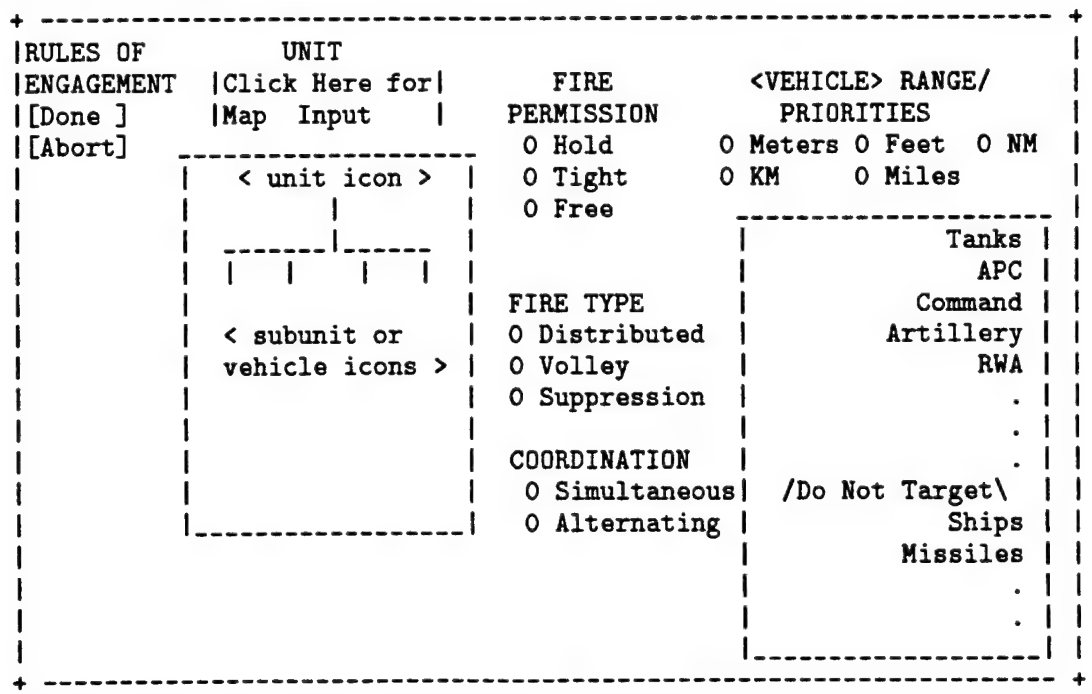
The Rules of Engagement (ROE) editor lets you set the fire permissions and target priorities for a unit. It is a tool that can be invoked at any time on any unit, regardless of what you are doing. If invoked while you are in the Unit Operations editor, it defaults to working on the unit that was selected in the Unit Operations editor.

Changes that you make at a level automatically cascade to all lower levels (i.e., change the rules of engagement for a company, and all its platoons will be changed also). These changes do not take effect until you press Done or change to a different unit.

Since the setting of rules of engagement was not available in ModSAF 1.0, you will need to re-set a unit's rules of engagement after loading a ModSAF 1.0 scenario.

To set rules of engagement:

1. Click the ROE button (second column, second red button). A display similar to the following example appears in the Editor Area. The unit for which you are setting the rules appears as a hierarchical task organization diagram. Also, the word "Unit" with an arrow points to the unit's icon on the Map.



2. Identify the unit. By pressing the ROE button immediately after creating a new unit, the system defaults to the newly created unit. By pressing it when you are in the Unit Operations

editor, the system defaults to the unit you are working on. In other cases, it probably won't default to anything, so you will need to choose a unit from within the editor. Choose a unit by clicking on the `Click Here for Map Input` button, and then selecting a unit from the Map. For the currently selected unit, the ROE editor displays all settings that apply to that unit including those that were explicitly set, as well as those inherited from a superior. (If you select a Unit, and want to assign rules of engagement to one of that unit's subunits only, click on the subunit's icon in the task organization diagram.) Note: Always verify that you have the correct unit by observing which unit the "Unit" and arrow label is pointing to on the Map.

3. When necessary, change settings. These changes are made to the selected unit and its subordinates. This downward cascading of values is per-field only (for example, if you change the Fire Permission for a company, it does not change the setting of the subordinate's Target Priorities). Directions for making changes include:
   - Fire Permission: click on the appropriate toggle. "Free" permission allows shooting, "Hold" permission forbids shooting, and "Tight" permission means return fire only after receiving fire.
   - Coordination: click on the appropriate toggle. "Alternating" means that vehicles in a unit are paired and coordinate shooting so that only one member of the pair shoots at a time. "Simultaneous" means that vehicles can shoot without being constrained to wait for a coordinating partner.
   - Firing Type: click on the appropriate toggle. "Distributed" means the vehicles in a unit attempt to target an enemy that isn't already targeted. "Volley" means shoot without needing to distribute targets. "Suppression" means a vehicle can remember where a target was for thirty seconds after it disappears behind an obscurant (such as a building or treeline); if a disappearing target was moving, its new position is dead reckoned from its last known position and velocity.
   - Target Range: click in the range window, press the SPACEBAR, and enter a new number. To change the measurement unit: click on the appropriate toggle. Note: The heading for the range setting area matches the unit type you are working on (<Vehicle> will be "Tank" for M1 unit, "APC" for M2 unit, etc.).
   - Target Priorities by vehicle type: Hold/Left on the desired target type in the list and drag it to a different position (toward the top to increase priority and toward the bottom to lower its priority). The type that tops the list is the first priority target. Drag a type to the bottom of the list (below "Do Not Target") to ignore it as a target.
4. Use an exit option:
   - Click `Done` to apply any changes and exit the editor.
   - Click `Abort` to ignore any changes and exit the editor.

6.4 Performing Immediate Interventions on a Unit

The Icon Strip, located between the Button Column and the Map, contains unit buttons marked with a military icon. These buttons are displayed in a single column; however the single column can expand to multiple columns with a scroll bar if there are too many unit buttons to fit.

The Icon Strip lets you select a unit and issue it an Immediate Intervention (II), which is similar to a military FRAGmentary Order (FRAGO). When you click on an icon in the icon list, a menu appears listing the II operations for that unit. You can drag directly to an operation, or release and then click on an operation. A partial list of IIs includes: attack, attack by fire, halt, advance to position, withdraw to position and change rules of engagement.

Which icons appear in the icon list is determined by three factors: the SAFstation privilege level, the SAFstation local force setting, and a unit's commanded by setting. For example, in Commander privilege level only icons for units commanded by the SAFstation display. However, in Battlemaster privilege, icons for units that match the SAFstation's local force setting display in addition to icons for commanded units.

Assume two SAFstations (A and B) are running ModSAF with the same PO database and exercise ID. SAFstation A commands an M1 platoon and SAFstation B commands a T72 platoon. SAFstation A has its local force set to friendly only. In Commander privilege, an M1 platoon icon appears in the icon list since SAFstation A commands it. In Battlemaster privilege, SAFstation A still shows only the M1 platoon icon because the local force is friendly.

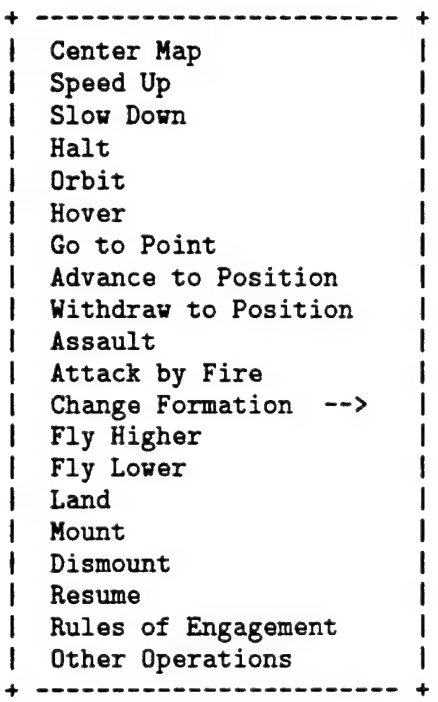
In the above example, suppose the battlemaster instructed SAFstation A's alignment to be both friendly and enemy. In Commander privilege, an M1 platoon icon would appear since it is a unit commanded by SAFstation A. In Battlemaster privilege, however, SAFstation A would now show both platoon icons because the local force is both friendly and enemy.

If the composition of a unit changes, its unit button changes accordingly. If a unit is removed from the simulation, its button disappears from the icon list.

When you move the mouse pointer to a button in the icon list, small arrows appear beneath all the vehicles that functionally compose that unit. Note that the location of the mouse is not currently tied to the Show As command. Therefore, if you are showing platoon icons only, you will continue to see arrows in the vehicle locations.

To view an Immediate Intervention menu:

1. Create a platoon.
2. Click on its button in the Icon Strip to get a menu of available immediate interventions (also referred to as TACtical Emergencies (TAC/Es)). Note that different unit types have different immediate interventions. Items written in grey are inactive. The following list shows immediate interventions.



The meaning of these interventions is described below:

- **Center Map** centers the Map around the selected unit.
- **Speed Up** increases the unit's current speed by modifying the movement task.
- **Slow Down** decreases the unit's current speed by modifying the movement task.
- **Halt** causes ground units to stop by assigning the halt task.
- **Orbit** causes FWA and RWA to fly in a circle over their current position by assigning a hold task.
- **Hover** causes RWA to hover over their current position by assigning a hover task.
- **Go to Point** calls up the Point editor so that you can specify a destination point. A movement task is assigned to permit the FWA or RWA to fly to the point.
- **Advance to Position** calls up the Point editor so that you can specify a destination point for advancing ground units. A movement task is assigned to permit the ground units to move to the point.
- **Withdraw to Position** calls up the Point editor so that you can specify a destination point for withdrawing ground units. A withdraw task is assigned to permit the unit to withdraw to the point.

- **Assault** calls up the Point editor so that you can specify an assault point. An assault task is assigned to permit the ground units to move to the point in line formation. The unit's fire permission is automatically set to Free. Once enemy is detected or the assault point is reached, the unit occupies a defensive position.
- **Attack by Fire** calls up the Point editor so that you can specify a destination to which the ground units can move. A movement task is assigned to permit the ground units to move to the point in line formation. If an enemy is detected, the unit automatically performs the Attack by Fire reaction which results in the unit occupying a defensive position.
- **Change Formation** brings up a submenu that lets you select a new formation to use as a modification (an override) in the movement task.
- **Fly Higher** causes FWA and RWA to increase their altitude by modifying the movement task.
- **Fly Lower** causes FWA and RWA to decrease their altitude by modifying the movement task.
- **Land** causes RWA to land immediately by assigning the land task.
- **Mount** instructs dismounted DI to mount their Infantry Fighting vehicle (IFV) by assigning the mount task.
- **Dismount** instructs mounted DI to dismount their IFV by assigning the dismount task.
- **Resume** causes the unit to return to its original frame after it was interrupted or to return to its original task parameter settings after a task modification or override.
- **Rules of Engagement** brings up the unit's Rules of Engagement editor. See Section 6.3 [Setting Rules of Engagement], page 51.
- **Other Operations** brings up the Unit Operations editor (described in the next section). If you choose this on a unit when you are already in the Unit Operations editor, the editor switches to that unit as if you had chosen it on the Map.

6.5 Performing Operations on a Unit

There are two ways to access the Unit Operations editor.

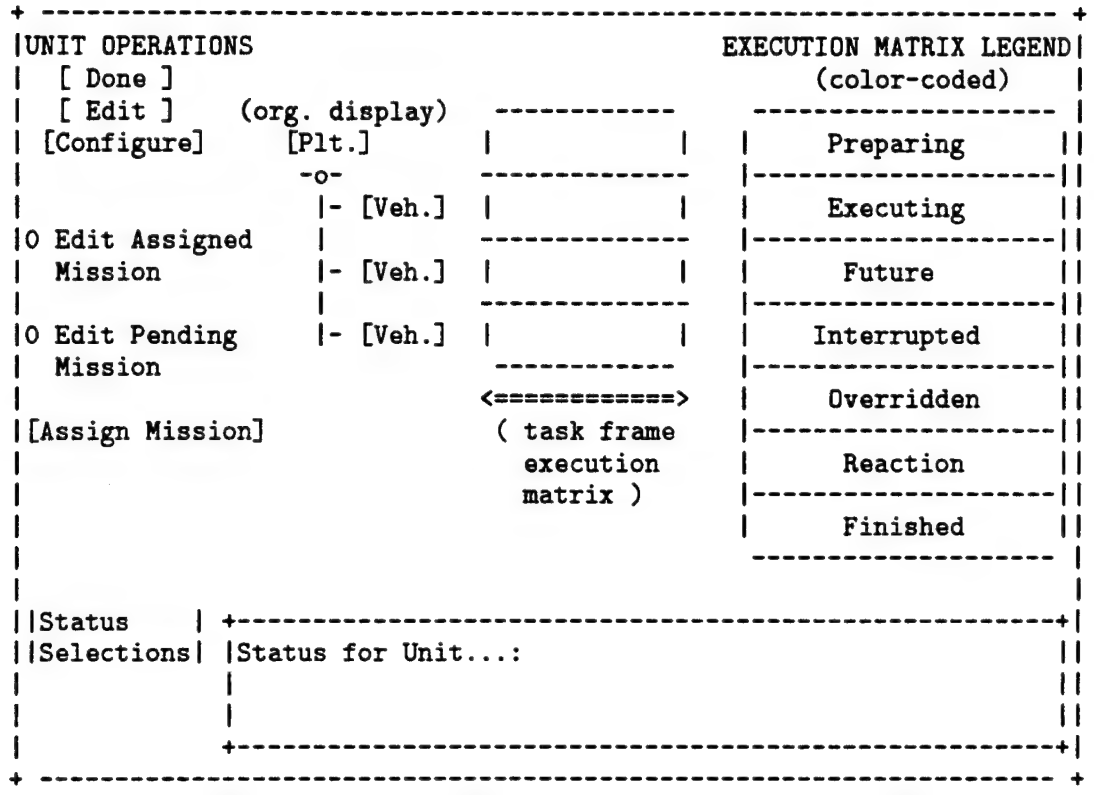
- Click the Select button (marked with an arrow) and then click on a vehicle or unit from the Map.
- Click on a unit's icon in the Icon Strip, then select the `Other Operations` immediate intervention. See Section 6.4 [Performing Immediate Interventions on a Unit], page 53.

If the Unit Operations editor is already displayed, then these operations leave it posted, and the new unit should be selected. Note: If a vehicle that is part of a platoon is selected, and the Unit Operations editor is not already posted, then that vehicle's platoon is selected and displayed in the editor. This happens because you usually want to give an operation to the entire platoon and not just the single vehicle.

When you select a tasked unit from the Unit Operations editor, then icons representing the unit's perception of other forces can display in the Map. These situational awareness icons appear as white boxes with a dashed rectangular outline. Ground units display as generic boxes, while FWA and RWA display as unit icons.

To view the Unit Operations editor:

1. Create an M1 platoon.
2. Click on a platoon vehicle in the Map to access the Unit Operations editor. An editor similar to the sample below appears.



3. The Unit Operations editor has several distinct areas. They are described below:

   - An organizational display (org. display) shows the task organization of the selected unit (companies into platoons, platoons into vehicles, etc.). Displayed vertically, it also acts as the row labels for the task frame execution matrix.

     The org. display symbols are toggle buttons for each unit in the displayed hierarchy. Each button shows a military icon; and, when possible, is annotated with a call sign. The hierarchy displays vertically, with superiors at the top and subordinates beneath their superiors. The currently selected unit's button appears recessed. To select a unit to command, click its button in the org. display. Note: You can select only one toggle button at a time.

     In the figure above, the small "-o-" symbol drawn under the platoon button represents buttons you can use to show or hide the rows of the matrix for the unit's subordinates. These buttons control the size of the org. display. To show or hide a unit's superiors or subordinates, click one of these buttons (labeled with either a "+" or "-").

   - A task frame execution matrix is located in the middle of the Unit Operations editor. You use this matrix to set up and issue mission commands. Since the matrix is color-coded, a legend appears next to it to explain what the various task frame colors mean with regard to task frame status. The execution matrix can be of unlimited length; it can be scrolled as needed. Mission commands issued with the execution matrix are explained in the next chapter.

- Mission editing buttons and an "Assign Mission" button are located left of the execution matrix. Each unit can have two missions: an assigned (or current) one and a pending (or alternate) one. Both missions can be saved to, or loaded from, a scenario file. See Section 9.1 [File Subcommands], page 89.

  When you access the Unit Operations editor, the execution matrix displays the assigned mission by default. To create or edit a pending mission, click the button marked **Edit Pending Mission** and fill in the execution matrix. To switch back without executing the pending mission, click **Edit Assigned Mission**. Clicking a mission editing button when that matrix is currently showing has no effect.

  To assign the pending mission, click **Edit Pending Mission** to display the pending mission in the execution matrix and then click **Assign Mission**. The pending mission, which now becomes the assigned mission, is executed and the Map display automatically switches to viewing the new mission. The previous contents of the assigned mission is lost.

- A Status Selections button and the Status Monitor (a status display area) are located at the bottom of the editor to let you monitor the unit's set of current mission tasks. Clicking "Status Selections" invokes a pulldown menu listing the selected unit's current tasks. These are the tasks that the unit is executing. Tasks selected from the list will have their status periodically updated on the Status Monitor. Several different task status messages can be displayed at once. An example Status Monitor display is:

```
+ ------------------------------------------------------------ +
|Status for unit <label>:                                      |
|                                                              |
|**** Task Name  ****   : ** Task Status **                    |
|                                                              |
|        Enemy Detection: No vehicles spotted                  |
|               Threats: Looking for a target                  |
+ ------------------------------------------------------------ +
```

- The upper left corner of the Unit Operations editor has three buttons: Done, Edit and Configure.

  - Click **Edit** to bring up the Unit editor (see Section 6.1 [Creating a Unit], page 48), which lets you make changes to vehicle parameters such as call sign, supplies, etc. Some parameters cannot be changed after a unit is created, specifically, this includes: Type (M1, T72, etc.) and Methodology. Changing alignment is allowed, although it is not guaranteed to be interoperable with other systems (some simulators may assume alignment is static). To make location and direction changes to a ground vehicle (to fine tune its position), edit its green orientation point since changing location with the Edit button does a teleport which you usually want to avoid. Changing location with the vehicle's orientation point makes the vehicle drive to the new location. The orientation point appears as a circle with an arrow through it. Moving a vehicle's orientation point when the arrow is solid (not dashed) tells the vehicle to drive and/or turn.

- Click **Configure** to bring up the Configuration editor. This editor consists of a collection of buttons, one for each of a vehicle's modifiable subsystems. Only vehicles, not units, can be configured. (In ModSAF, a vehicle is composed of many subsystems, i.e. dynamics, vehicle spotter, tasks, etc. We refer to these as the subsystems.) These subsystems can be viewed or modified. To view or edit the parameters of a subsystem, click on its button. To make changes, use the resulting subsystem editor.
- Click **Done** to exit the Unit Operations editor.

4. When finished viewing the Unit Operations editor, click **Done** to exit. An alternate way to exit is to click on another unit in the Map. This alternate way means that you are not required to click **Done** when issuing operations to units.

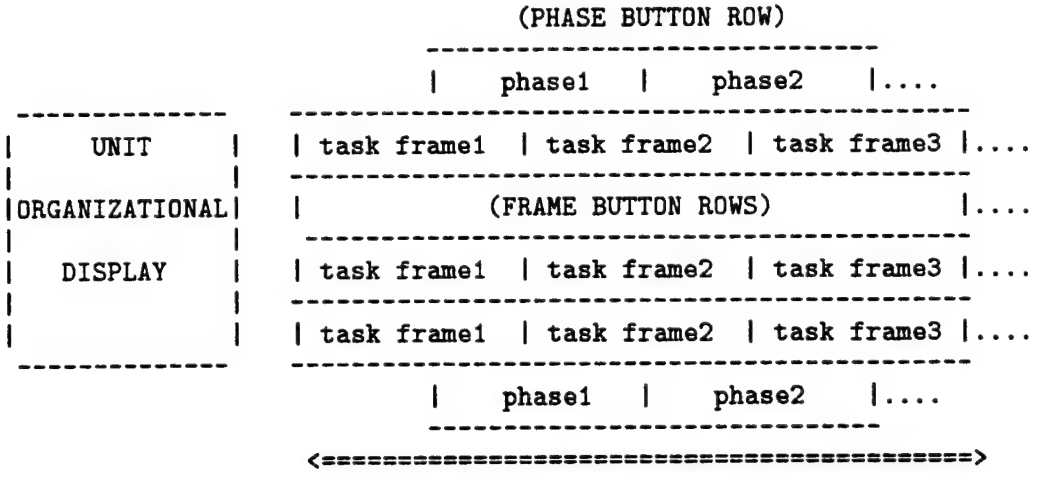
7 Mission Operations

A ModSAF exercise contains simulated objects that exhibit capabilities similar to those of "manned" simulators, such as driving or flying over the terrain and firing at enemy objects. You can command a simulated object to execute a mission consisting of one or more phases. Each mission phase contains a task frame which contains of a collection of tasks executing in parallel.

A mission consists of both a subject and action(s). The subject is the tasked unit; the actions are the tasks frames the unit executes during each phase of the mission.

Task frames and phases are created using the execution matrix in the Unit Operations editor. This mission planning tool lets you represent the phases of a mission and the actions performed during each phase. The matrix has a column for each phase of the mission. For unit tasking, an execution matrix has one row for the entire unit so you can give a mission to the unit as a whole. For subordinate unit tasking, an execution matrix has a row for each of the unit's subordinates so you can give a mission to each subordinate.

The layout of the execution matrix is shown below.



The execution matrix is divided into the following rectangular areas, each with its own function:

- Phase Button Row - This area, across the top of the matrix, contains buttons that become active when it is time to identify a phase transition. When you click an active phase button, the phase editor appears to let you select or modify a phase's transition type. After you specify

transition data for a phase, the phase label displays it. The label, "Continue" indicates an automatic transition, the name of a graphic indicates a control measure transition, and a time countdown indicates an HHour or duration transition.

- Org. Display - This area, on the left side of the matrix, identifies the units you can task.
- Frame Button Row - This area, a unit's row across the matrix, contains buttons that become active when a frame is to be specified for the units in a phase. After a frame is supplied, the button label changes to indicate the frame name.

The org. display area on the left side of the matrix serves three purposes: (1) it displays the task organization of the unit; (2) it identifies the contents of each matrix row; and (3) it controls the display of planning overlays and status.

- Task Organization - The display of units should indicate the correct task organization of the unit. Use the scroll bar on the left if the task organization is not completely visible. To show or hide superiors or subordinates, first select a unit, then click one of the plus (+) or minus (-) buttons that appear to the left of that unit.
- Row Headings - The execution matrix tracks the vertical position of the task organization display. When the you change the display, the execution matrix updates automatically. When you scroll the display, the matrix should scroll to the corresponding position when you release the mouse button.
- Planning Overlays and Status - One unit in the org. display is always selected (indicated by a button with a darker background color, a pressed-in appearance, and adjacent +/- buttons). The Map should display the planning overlay of the selected unit, and, the status monitor should show the status of the selected unit.

The cells of the execution matrix are colored to visually indicate which part of the mission is being executed by each unit. The Execution Matrix Legend indicates the meanings of the colors. Each cell also contains a label indicating what the unit is currently doing. If the unit is executing a temporary action, the action that was suspended is enclosed by braces in the label.

The following table lists the colors used to code the matrix cells:

Pale Gray:

Cell is empty

Dark Gray:

Cell execution has been completed

Pale Yellow:

Unit is preparing to execute cell, or is waiting for an On Order

Green: Unit is executing cell

Bright Green:

Cell has been temporarily interrupted (with the "Replace Temporarily" option)

Pale Green:

Task in cell has been temporarily overridden (with the "Modify Temporarily" option or by the selection of an action from the icon strip)

Bright Red:

Reaction is executing

Pale Red: Unit has not reached the cell yet

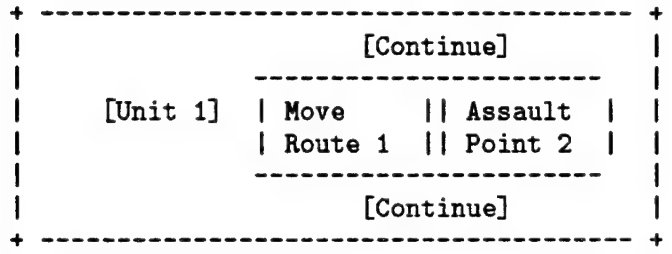
The execution matrix lets you specify the frames and the phase linkage in a mission. There are two ways to link phases: automatic execution and conditional execution.

1. Automatic - This links the frames with the `Continue` transition (which implies a sequential order of execution between frames) . An automatic transition means that a new frame starts when a previous frame ends, for example, when vehicles reach their destination. Since many frames (such as Hasty Occupy Position and Halt) do not end, it is suggested that you make the frame that follows an automatic transition an On Order frame. To do so, set its `On Order` toggle to on by selecting `On Order` from the frame's cascading list of modification options.
2. Conditional - This links the frames with a Control Measure, Signal, Duration, or HHour transition. Control measure transition means that a new frame starts when a specified control measure, such as a phase line, is reached. A duration transition occurs when a phase has been executing for a specified period of time. An HHour transition occurs when a phase detects that a time before or after an HHour is reached.

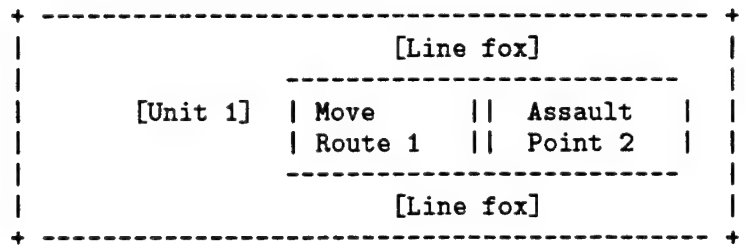
   Note: Ignore the Signal transition since ModSAF vehicles do not currently run a signal detection task. If they did, this transition type would cause a transition when the vehicle detected a visual signal such as smoke or a flare. See Section 14.3.6 [Signal Flares and Signal Smoke], page 134.

These conditional transitions work for both air and ground vehicles, and with saving/loading scenarios. When you load a scenario that was created using various HHours, the HHours will be converted to the same offsets that they were in the original scenario. These transitions do not occur during reactions.

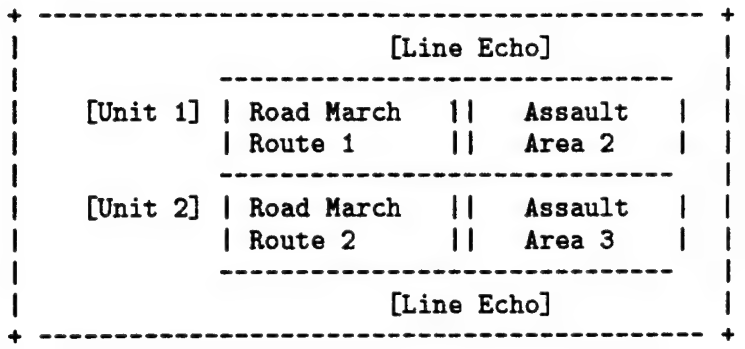
A matrix showing an automatic multi-phase mission for Unit 1 follows. The start frame is a Move frame on the line graphic named "Route 1". The second phase frame is an Assault on the point graphic named "Point 2". During mission execution, when Unit 1 crosses the end of Route 1, the second phase of the mission begins.



A matrix showing a conditional multi-phase mission follows. The start frame is a Move frame on the line graphic named "Route 1". The second phase frame is an Assault on the graphic named "Point 2". During mission execution, when Unit 1 arrives at the line control measure named "fox", the second phase of the mission begins.



The execution matrix lets you keep units in phase. The following sample matrix keeps Unit 1 and Unit 2 in phase with each other. The start frame for Unit 1 is a Road March frame on the graphic named "Route 1". The start frame for Unit 2 is a Road March frame on the graphic named "Route 2". The second phase of the mission will not start until both units arrive at the line control measure named "Echo".



To modify the matrix, simply click on a cell and make a selection from the pulldown menu. You can edit any cell of the matrix (including the phase labels) at any time. As with the Menu Bar and the Icon Strip, you can either click and release each button, or click and drag through the system of menus.

Depending on the context, the following options may be available:

Select — Displays when a cell is empty or when clicking a phase label. If a task frame choice is selected from the pulldown menu, it will be placed in the cell. If there are forced choices (for example, the route argument to a Move task frame) a task editor will be posted. To modify other arguments of task frames, see the "Modify task..." description, below.

On Order — Use to change the "On Order" status of the selected task frame. By default, a task placed in the left-most cell is automatically On Order. You can make any frame an On Order frame by clicking its cell, and choosing the "On Order" toggle before the cell starts executing.

Replace with...

Use to replace the contents of the cell with a different task frame. Task editors are started to get forced choices. If the original task frame is being executed, it cannot be replaced; instead, the selected task frame is placed immediately after the executing frame and configured to start right away.

Modify task...

Use to change one of the tasks in the task frame.

To Next Phase (or Remove)

Use to remove the task frame from the matrix. If the task frame is being executed, it cannot be removed; instead, the next task frame is modified so that it starts right away. If you remove the last task frame in a row while it is being executed, the entire row is cleared.

Replace Temporarily

Use to temporarily replace the currently executing task frame with another task frame. Task editors are started to get forced choices.

Modify Temporarily

Use to temporarily change the parameters of a task in the currently executing task frame.

Resume Use to resume execution of whatever was suspended with Replace Temporarily or Modify Temporarily.

Stop Reaction

Use to stop a reaction.

Change Reaction

Use to modify the parameters of the task that triggers the currently executing reaction.

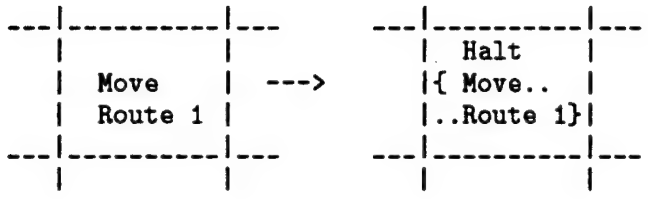
You complete a simple execution matrix using pulldown menus that let you select the task frame you want to place in a cell. Once a cell is filled in, you have a choice of modification options to permit interruption of an executing frame via "Replace Temporarily", addition of a frame for the next phase via "Replace", and cancellation of a frame via "To Next Phase" or "Remove". These options are shown in the following example.

```
Replace with ...     --> Cascades to list of alternate frames
Replace Temporarily --> Cascades to list of alternate frames
To Next Phase
```

If the selected cell happens to be the one being executed by the unit (indicated visually, with color), you can issue interrupts via "Replace Temporarily" and overrides via "Modify Temporarily". This choice of modification options is shown in the following example.

```
Replace Temporarily    --> Cascades to list of alternate frames
Modify Temporarily     --> Cascades to list of frame's tasks
```

If you select "Replace Temporarily", the new frame is written on top of the original cell, indicating the suspension. This is illustrated below:



The cell will have its original frame enclosed in brackets, and the added frame would appear to be stacked on top of the original. Clicking this overlaid cell would give you the following choices:

```
Resume
Replace with...      --> Cascades to list of alternate frames
Replace Temporarily --> Cascades to list of alternate frames
Modify Temporarily  --> Cascades to list of frame's tasks
```

You can stack multiple interrupts on top of one another.

Simulated units can alter their behavior from the strict parameters of a mission in response to battlefield conditions such as spotting an enemy or receiving an air attack. When that happens, reactive behavior such as running for cover or occupying a battle position, can occur. The SAFstation signals you that a reaction is taking place by inserting a highlighted "Stop Reaction" option in the modification options list. If you select "Stop Reaction", the unit stops reacting to this particular situation; however, if a new situation occurs (for example, spotting another enemy after this one has disappeared) the unit would execute the reaction again. The unit does not continue reacting to the same situation but will react to a new one.

You can alter a frame's reaction choices during a reaction by selecting the "Change Reaction" option. This posts an editor for the reaction handling task. If you change parameters for the reaction handling task, those changes become the new reaction rules for the frame. See Section C.10 [Actions-on-Contact Task], page 198, see Section C.39 [React-to-Contact Task], page 215, see Section C.13 [React-to-Indirect-Fire Task], page 201, and see Section C.11 [React-Air Task], page 200.

Automatic reactions are displayed using the frame stacking technique described previously (although the cell does appear with a different color), and the menu of modification choices is different.

Controlling at multiple levels of the hierarchy simultaneously can be achieved using the execution matrix. For example, suppose you have assigned a platoon the following matrix row:

```
|        |--------|---------|-----
|-[PL]   | Move   | Assault |
| -o-    | Road 1 | Obj 2   |
|        |--------|---------|-----
|-[PL]   |        |         |
```

You now click under the platoon to show its vehicles:

```
|        |--------|---------|-----
|-[PL]   | Move   | Assault |
|  |     | Road 1 | Obj 2   |
|  |     |--------|---------|-----
|  |-[V1]|.Move...|.Assault.|.....
|  |     |.Road.1.|.Obj.2...|.....
|  |     |--------|---------|-----
|  |-[V2]|.Move...|.Assault.|.....
|  |     |.Road.1.|.Obj.2...|.....
|  |     |--------|---------|-----
|  |-[V3]|.Move...|.Assault.|.....
|  |     |.Road.1.|.Obj.2...|.....
|  |     |--------|---------|-----
```

The matrix shows that the vehicles are executing their superior's mission, but it is visually indicated (by color and font) that they are really just parroting their superior's assignment.

Now, if you click on one of these subordinate's cells, you will be presented with the narrower list of choices:

```
Replace Temporarily    --> Cascades to list of alternate frames
```

If you choose to replace the frame with an independent mission, then the vehicle will go off and do something different. The lists of modification choices for that frame would then include "Resume", so that you could tell the independent subordinate to resume its superior's mission.

The same techniques are used for company and battalion missions, although the subordinates' cells might actually be different (since they would be running task frames created by the company or battalion). You are allowed to tell the platoon to go do something independent of the company

and to tell the company to do something independent of the battalion. The superior will be required to deal intelligently with the loss of the subordinate.

7.1 Setting Up a Single-Phase Mission

To create a single-phase mission:

1. Create an M1 vehicle. Note: Begin with a small unit such as a single vehicle or a platoon when you practice using the execution matrix.
2. Bring up the Unit Operations editor by clicking the vehicle icon on the Map.
3. Click in the vehicle's first execution matrix cell. Click **Select**.
4. Click **Move** from the cascading list of available frames. The Move frame contains a movement task (Travel) that needs a destination. When the Travel editor appears, click in the Map to supply a destination point and then click **Done**.

   Note: a destination can be either a point or a route. You can supply a route by clicking it or you can use the Line editor (accessed by the Line button) to create a new route.
5. Note that the frame name now appears in the cell. The cell is pale yellow indicating that it needs an On Order authorization before executing. ModSAF makes the first frame in a movement mission an **On Order** frame. The vehicle does a Halt task while waiting for you to authorize a Move frame.
6. Click **On Order** when it appears in the Menu Bar at the top of the screen.
7. Click the frame name in the resulting pulldown menu of pending frames. The vehicle should move. Note: If you click **Done** in the Unit Operations editor before making the On Order authorization, you exit from the editor without starting mission execution.

7.2 Setting Up a Task Frame

You set up a task frame by providing parameters for the frame's tasks or by changing its On Order status. To set up a task frame:

1. Create and execute a single-phase mission.
2. To tell the unit to temporarily do something different, click on the executing cell in the execution matrix. Select the **Replace With** or **Replace Temporarily** option. A cascading list of frames that are valid for the selected unit appears.

3. Select a new task frame by clicking on its name. If the frame has a task requiring input, an editor for that task appears and the Current Editor Help prompts you (in red) for that input.

   For example, an Assault frame needs a location because its assault task needs an attack point. You can either select a graphic from the Map or you can create a point by clicking in the Map. Click **Done** in the task editor when you have provided data. After the frame is specified, you will see its name appear in the execution matrix cell.

4. To modify the unit's behavior without changing the frame itself, click on the executing cell in the execution matrix. Select the the **Modify Task** or **Modify Temporarily** option. Selecting these options gives a cascading list of the tasks in that cell's frame.

5. To examine or edit a task, click on the task name. An editor appears letting you view or change the task's parameters. Click **Done** when you have finished editing parameters or click **Abort** to exit ignoring any changes. A sample task editor with a representative list of task parameters is shown below.

```
+ ------------------------------------------------------ +
|<TASK NAME>          Route                Speed  Formation  |
|             [Click Here for Map Input]     40     Wedge    |
| [ Done ]                                                   |
| [Revert]                                                   |
| [Abort ]                                                   |
+ ------------------------------------------------------ +
```

6. To require the new frame to wait for user authorization before executing, set its **On Order** toggle to on. This informs ModSAF that a user-supplied authorization is required before the frame's actual task can execute. **On Order** appears in the Menu Bar at the top of the screen whenever On Order frame(s) are ready for this SAFstation to command. The On Order pulldown menu shows the pending items that are waiting for authorization. You issue the corresponding On Order authorization by selecting the pending item from the pulldown menu. This will cause the frame to start execution.

7.3 Tasking a Subordinate

When you select an empty cell in an execution matrix, the **Subordinate Tasking** option appears at the bottom of the list of possible task frames.

There are three ways you can set up a mission for a unit that has subordinate subunits or vehicles:

1. Select the execution matrix cell for the unit and assign a task frame. All subunits will do that same task frame at the same time.

2. Having done 1. above, select the execution matrix cell for one of the subunits or vehicles. Choose a Replace or Modify command, and give it a different task frame. That subunit will now do its new task completely independent of the rest of the unit.
3. Click **Subordinate Tasking** when you select a task frame for the unit. You can now assign different task frames to the subunits or vehicles, but they will complete their tasks in a coordinated manner, rejoining the unit once their task is done and proceeding as a unit to the next phase of the mission.

7.4 Adding Phases to a Mission

To extend a mission:

1. Create and execute a single-phase mission.
2. To extend the current mission, specify the contents of the unit's right-most cell in the matrix.
3. A phase transition, which defaults to "Continue", appears. To specify a different type of transition, click this **Continue** button (on the top or the bottom, it doesn't matter), and select a phase trigger from the pulldown menu. (Setting up phase triggers, such as a control measure, duration, or HHour time, is explained in the following sections.

Note: In most cases, when you select a new frame for a cell, the frame is placed in the selected cell. However, if the cell comes after an empty cell and there is no phase trigger between the two cells (the label is "Continue"), the new frame is placed in the earlier cell, to accurately reflect what will happen when the mission is executed.

7.5 Setting Up a Multi-Phase Mission

A multi-phase mission has two or more phases. You create it by specifying task frames and the conditions for transitioning between them.

Follow the instructions below to create a two-phase mission. You can build a mission with more phases by including more frames and phase transitions.

1. Create a ground vehicle. Click on the vehicle in the Map to bring up the Unit Operations editor. See Section 6.5 [Performing Operations on a Unit], page 56.

2. Assign the vehicle a Move frame. The first frame in a Move mission has its `On Order` toggle automatically on. This means that the vehicle halts while waiting for Move authorization.
3. Click the next cell. Choose `Select` to include the second phase frame. Select a frame.
4. The phase button bridging the gap between the two frame columns now displays the label, "Continue". Click the `Continue` button. A menu of phase transition types (Continue, Control Measure, Duration, Signal, or HHour) appears.
5. Select `Continue` to tell the vehicle to transition when the previous phase is finished (which means arrival at the destination point or end of the route). Directions for setting up the other transition types are provided in the sections that follow.
6. If you made a mistake creating the execution matrix, you could edit a task frame. To do so, select its cell. Choose the `Replace` modification option from the cascading list of choices. Note that the frame editing function is available when you are creating an execution matrix and also during mission execution.
7. Issue the On Order authorization when you are satisfied with the set up of the execution matrix and want to execute the first frame. To do so, click `On Order` in the Menu Bar and select the pending frame.

7.6 Creating a Control Measure Transition

A control measure transition occurs when a unit detects that it is about to cross a control measure (a line, point, or text). Using a line (rather than a point or text graphic) helps insure that the control measure is close enough to be considered crossed (50 meters for ground vehicles, 150 meters for helicopters, and 500 meters for airplanes).

You can also set up the control measure transition to occur when another specified unit crosses the control measure. See Section E.10.2 [Specified Unit Control Measures], page 240

To specify a control measure transition for your unit, you must select the control measure that needs monitoring.

1. Create a platoon and assign it a Move frame (On Order - by default). Assign it a Halt frame in the next execution matrix slot.
2. Click the `Continue` button that appears at the top of the execution matrix between the two task frame columns. Select `Control Measure`.
3. Use the Line button to create a line between the platoon and the end move point so that the vehicles will cross this line before they reach the end destination. Click `Done` in the Line editor. That line is set as the control measure to monitor. Click `Done` in the Control Measure editor.

4. Select **Move** from the On Order menu at the top of the screen. The platoon moves toward the point and when the vehicles reach the line control measure they should halt. Note: if you create a control measure line far from the vehicles and the vehicles reach their destination point before reaching the line, the platoon executes the Move task frame, and then executes the Halt task frame upon arrival at the destination point.

7.7 Creating a Duration Transition

To create a duration transition, follow these steps:

1. New Scenario.
2. Create a platoon and assign it a Move frame to a destination 10 km or more away (On Order - by default). Assign it an Assemble frame in the next execution matrix cell.
3. Click the **Continue** button that appears at the top of the execution matrix between the two task frame columns. Select **Duration**.
4. Enter a time duration (for example: 1 min. 10 sec.)
5. Select **Move** from the On Order menu at the top of the screen. Notice the timer that appears as the phase label. The platoon moves toward the point and when the time is up, the platoon assembles. The duration displays in the execution matrix while it counts down to zero. Note: if you create a destination point so close that the vehicles reach it before the duration counts down to zero, the platoon executes the Move task frame, and then executes the Assemble task frame when the vehicles arrive at the destination point.

7.8 Creating an HHour Transition

An HHour transition occurs when a phase detects that a time before or after an HHour is reached. Note: If the HHour clock is not defined for an HHour transition, the start of the next phase will not depend on HHour; rather it will begin when the first phase ends on its own.

To create an HHour transition, follow these steps:

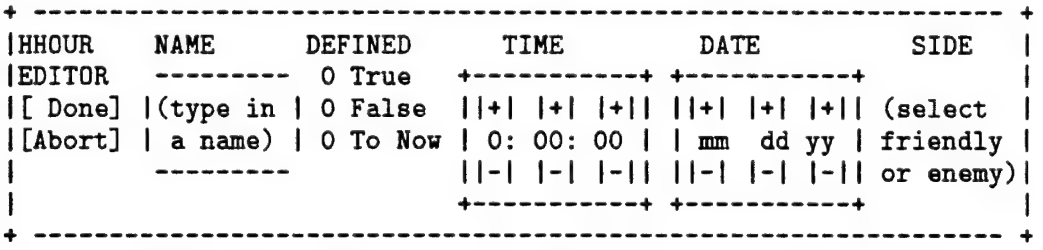
1. New Scenario.
2. Use the HHour button to create an HHour clock (you can use your initials as the clock name) whose HHour time (exercise start) is not yet set (change the Defined setting to "False").
3. Create a platoon and assign it a Move frame to a destination 10 km or more away (On Order - by default). Assign it an Assemble frame in the next execution matrix slot.

4. Click the **Continue** button that appears at the top of the execution matrix between the two task frame slots. Select **HHour**.
5. In the HHour offset time editor, select the the HHour clock (named with your initials) and set a positive time offset (for example: 1 min. 10 sec.). Note that the transition in the execution matrix reads "<HHour clock name> + 0:01:10" to indicate that the second phase will begin 1 minute and 10 seconds following the HHour time.
6. Use the HHours pulldown menu to access your HHour clock. Set the HHour (exercise start) time to the current time (change the defined setting to "To Now"). Note the expected transition time in the execution matrix.
7. Select **Move** from the On Order menu at the top of the screen. The platoon moves toward the destination point and when the HHour time plus offset is reached), the platoon assembles. Note: if you create a destination point so close that the vehicles reach it before the expected transition time, the platoon executes the Move task frame, but will not begin the assemble because the HHour plus offset was not met.

7.9 Setting HHour

You can define an HHour time and instruct a unit to proceed to the next phase of its mission when the HHour plus or minus an offset is reached.

1. Click on the HHour button (second column, fourth blue button). This button is labeled with a clock. A display similar to the following example appears in the Editor Area.



2. You can use the default HHour clock name or assign a unique name. To supply a name, click in the Name text box and enter a name.
3. If you know the HHour time, set Time and, if necessary, Date in the editor. If no date is set, the HHour will be today.
4. There are three choices for setting the Defined field:
   - If you have a definite time you want the HHour to be, select "True".
   - If you want to set up the HHour, but don't yet know what the exact time should be, select "False" (for example, you want a unit to do something ten minutes after the HHour, but don't know what that HHour time should be).

- If you want the HHour to be right now, select "To Now". The time will automatically match the clock in the Menu bar.

5. Select whether this is to be a HHour clock for the friendly forces or for the enemy forces.
6. When you are done setting the HHour, click **Done**. Notice that there is a button in the Menu Bar labeled **HHours**. If you click this button, a list of all the HHours you have created appears. This Menu Bar button lets you quickly access the HHour editor in case you want to edit an existing HHour.

7.10 Changing a Mission

You can change a phase transition by clicking the phase button and selecting a transition type.

You can add a frame to extend a mission. To do this, click in the unit's right-most cell and choose **Select** or **Replace** to create the frame.

You can also change a frame's parameters. To do this, follow these steps:

1. Click on the frame's cell in the execution matrix.
2. Select **Modify task** or **Modify Temporarily** from the cascading list of modification options. A list of editable tasks in that frame appears.
3. Select the task you want to modify.
4. Edit the parameters you wish to change when the editor for that frame appears. When finished editing, click **Done** on the task editor.

7.11 Using the Status Monitor

A status monitoring area that displays the state of a unit's tasks is located at the bottom the Unit Operations editor. You can see which tasks the unit is executing and decide which ones you want the status messages for. You can choose to display the status for one task or for several tasks.

To use the status monitor, follow these steps:

1. Create a platoon of ground vehicles. Click on a vehicle in the Map to bring up the Unit Operations editor. See Section 6.5 [Performing Operations on a Unit], page 56.
2. Assign the platoon a movement frame and issue the On Order.

3. Click **Status Selections** on the left side of the Unit Operations editor. The tasks the platoon is actively executing appear in a pulldown menu. Each task has a toggle. Setting a task's toggle on (appears recessed) tells ModSAF to show that task's status in the Status Monitor. By changing task toggles, you control which status messages are displayed. For example, setting the Enemy Detection task toggle on, tells you what the platoon detects. A sample Status Monitor is shown below:

```
+ ------------------------------------------------------------ +
|Status for Unit <unit label>: ...                             |
|                                                              |
|**** Task Name ****: ** Task Status **                        |
|                                                              |
|    Enemy Detection: Aware of these vehicles: a11, a12        |
| Actions on Contact: Monitoring incoming rounds and enemy spotted |
|          Traveling: Following route <route name> in <formation>  |
|                      at <speed>                              |
|             etc. : etc.                                      |
+ ------------------------------------------------------------ +
```

7.12 Interrupting a Mission

During a multi-phase mission, one phase ends and ModSAF then automatically assigns the next phase (a new frame just takes the place of the old one). However, you might want to interrupt a unit's current frame at times. You can do this with the **Replace temporarily** option. For example, you can interrupt a platoon's Move frame with an Assault frame. This lets you resume the Move while the Assault is running since the Move was interrupted rather than terminated. When you decide to resume, select the executing cell in the execution matrix and click the **Resume** option. This operation removes the interrupting frame from the top of the unit's "to-do" list leaving the previous frame at the top. This suspended frame then resumes execution.

To interrupt a mission, follow these steps:

1. Create a ground vehicle. Click on the vehicle in the Map to bring up the Unit Operations editor. See Section 6.5 [Performing Operations on a Unit], page 56.
2. Assign the vehicle a movement frame and issue the On Order.
3. When the vehicle moves, click on its frame cell. Select **Replace temporarily** from the option list.
4. Select a new frame from the cascading list and enter any required parameters for the new interruptive frame. See Section 7.2 [Setting Up a Task Frame], page 69. The vehicle should run the new frame.

7.13 Resuming a Suspended Mission

The **Resume** option appears in a frame's set of modification options when there is an interrupted frame that the unit can return to.

1. Create a ground vehicle. Click on the vehicle in the Map to bring up the Unit Operations editor. See Section 6.5 [Performing Operations on a Unit], page 56.
2. Assign the vehicle a movement frame and issue the On Order. When the vehicle moves, click on its frame cell. Select **Replace temporarily** from the list of options.
3. Select a new frame and enter any required parameters for the new interruptive frame. See Section 7.2 [Setting Up a Task Frame], page 69. The vehicle should now run the new frame.
4. When the interruptive frame runs, click the frame cell. Select **Resume** from the option list. The vehicle should run the original frame.

7.14 Overriding Task Parameters

To modify a mission, follow these steps:

1. Create a unit. Click on the unit in the Map to bring up the Unit Operations editor. See Section 6.5 [Performing Operations on a Unit], page 56.
2. Assign a frame to the unit.
3. Once the unit begins executing the assigned frame, click on the frame's cell. Select **Modify Temporarily**.
4. Select a task from the cascading list of executing tasks.
5. Enter parameter change(s) when the editor for the selected task appears. Note: A task editor has a **Revert** button to change the parameters to their original values.

7.15 Changing Reactions

The **Change Reaction** option only appears as a modification option during a reaction.

1. Create a T72M vehicle and an M1 vehicle close to each other.
2. Use the ROE editor to assign the T72M vehicle Hold fire permission.
3. Assign the M1 a Halt frame.

4. Click the M1 icon in the Map to bring up the Unit Operations editor. See Section 6.5 [Performing Operations on a Unit], page 56.
5. When the Contact Drill reaction occurs, click the **Halt** cell in the execution matrix. Select the **Change Reaction** option to access an editor for the reaction handling task. You can selectively change any of the task parameters. See Section C.10 [Actions-on-Contact Task], page 198.
6. After making changes, click **Done** in the reaction handling task editor. Changes made with the **Change Reaction** option are meant to endure the whole time the frame is executing.

7.16 Creating a Pending Mission

You can create a new pending mission before or while a unit executes a mission. This pending mission can be assigned whenever you want the unit to execute it. Once you assign the pending mission, it replaces the current mission making that mission no longer available.

To create a pending (alternate) mission:

1. New Scenario.
2. Create two cross-country routes (RT1 and RT2) that are somewhat parallel.
3. Create an M1 tank platoon. Set up an On Order Move task frame on route RT1 at the default speed and formation. The platoon moves when the On Order is issued.
4. While the unit is traveling the route, use the **Edit Pending Mission** toggle to set up a pending on order Move mission on route RT2.
5. After the vehicles have traveled on RT1 for a short distance, use the **Assign Mission** button to assign the pending matrix. The platoon will halt at its current location waiting for the On Order to execute its new mission. Assign the new On Order Move RT2 mission. Notice that the unit moves to RT2 to perform the new mission.

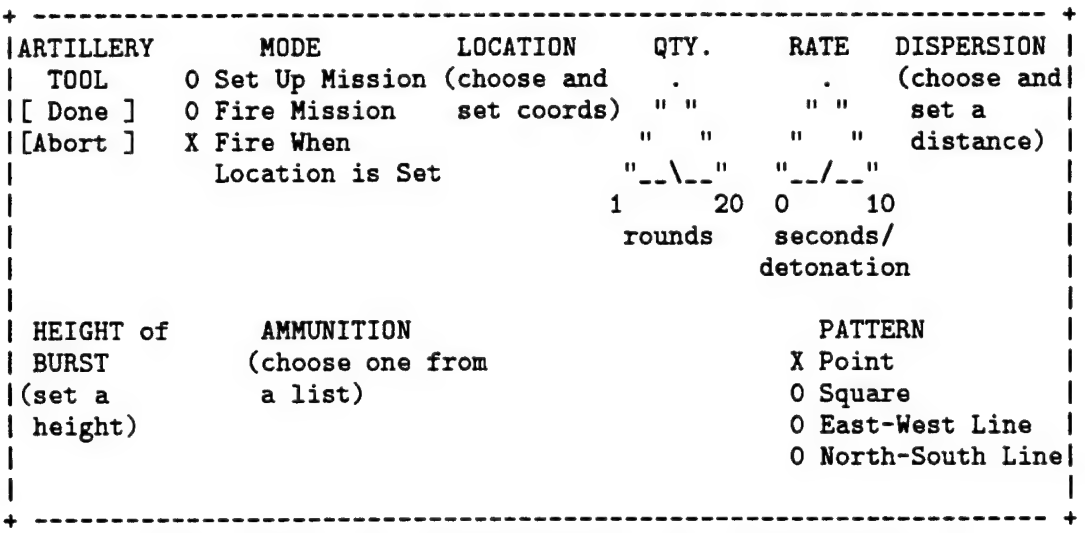
8 Combat Support

The Button Column contains an Artillery Tool button, a Minefield button, and a Fire Support button. The Artillery Tool button lets you generate an indirect fire mission without creating artillery vehicles. The Minefield button lets you simulate anti-tank and anti-personnel minefields. The Fire Support button lets you assign fire missions to artillery vehicles. Instruction for using these buttons is provided in this chapter.

8.1 Using the Artillery Tool

The Artillery tool lets you create an artillery mission. When artillery (indirect fire) detonates on the simulated battlefield, the Map displays a large purple star.

1. Click the Artillery button (first column, fourth red button). A display similar to the example below appears in the Editor Area.



2. To generate an artillery mission using the Fire Mission mode, do the following:
   1. Choose **Set Up Mission** mode.
   2. Set the parameters for impact location, quantity of rounds, rate of fire, impacting rounds dispersion distance, ammunition type, height of burst, and impacting rounds pattern.
   3. Choose **Fire Mission** mode. The artillery will fire and the mode will automatically reset to **Set Up Mission**. You can repeat the same artillery mission by again choosing **Fire Mission** mode, or you can fire a different mission by changing parameter(s).
3. To generate an artillery mission using the Fire When Location is Set mode, do the following:

1. Choose **Fire When Location Is Set** mode.

2. Set the Quantity, Rate, Dispersion, Ammunition, and Pattern parameters.

3. Set the Location parameter, when you want the mission to fire.

4. You can repeat the process of setting a new location to have the mission fire elsewhere.

4. When finished firing, click **Done**. If you want to exit the editor without firing a mission, click **Abort**.

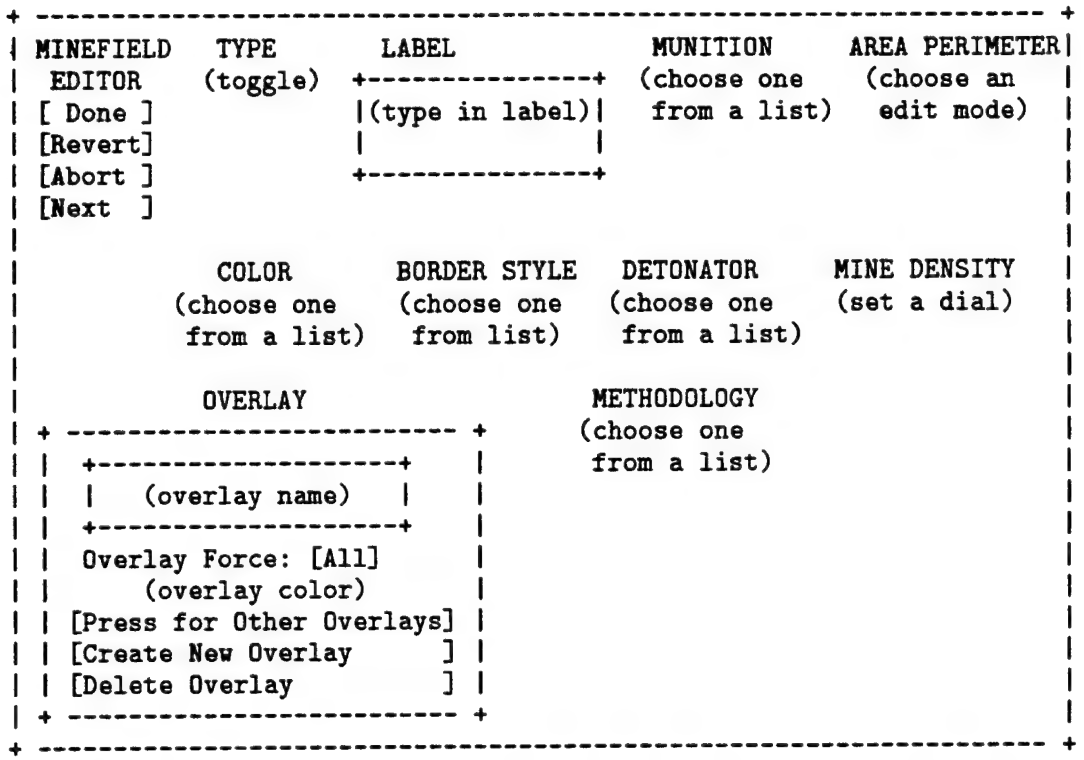
8.2 Creating a Minefield

The Minefield button lets you place and simulate anti-tank and anti-personnel minefields.

Note: A created minefield initially has a dotted border. This border becomes solid when the minefield is simulated by a SAFsim. On the machine where a minefield is simulated, exact locations are shown for each mine, whereas on other machines, approximate locations are shown.

Minefields reside in overlays, and overlays have an Overlay Force parameter that can filter information on the SAFstation Map. This permits you to mark a minefield by side so that the other side does not become aware of it. Therefore, a SAFstation assigned to one side (such as Friendly only) won't display minefields created on overlays belonging to the opposing side.

1. Click the Minefield button (second column, second blue button). A display similar to the example below appears in the Editor Area.



2. Click in the Map to position vertex points for the minefield perimeter. A minefield of the appropriate type appears, connecting the placed vertex locations.
3. Edit parameters when it is necessary. Directions follow:
   - To change the Type setting, click on one of the toggles. There are two types: Point and Area.
   - To change the Border Style, Munition type, Detonator type, Methodology, or Color, hold/Left on the current value and then select a new value from the displayed list. Munition type specifies either an anti-tank or anti-personnel mine. The file, `common/include/protocol/mun_type.h`, lists each munition type and specifies whether it is mineTargetTank (anti-tank) or mineTargetPerson (anti-personnel).
   - For area minefields, the editor provides a a Mine Density dial set with a default. If necessary, change the value (range is 1 - 100 meters) by moving the dial pointer.
   - If necessary, supply an overlay name, force, or color.
   - To change the default label, click in the Label box and enter text.
4. Select a button from the upper left corner:
   - Click **Done** to create the minefield and exit the Minefield editor.
   - Click **Next** to create the minefield and remain in the editor to create another minefield.
   - Click **Revert** to remove any new settings without exiting from the editor.
   - Click **Abort** to ignore any entered data and exit from the editor.

8.3 Using the Fire Support Tool

Use the Fire Support tool to create and assign fire missions. This tool differs from the Artillery tool (where you, the user, do the firing) in that simulated vehicles do the firing according to the vehicle and mission parameters.

The Fire Support tool uses howitzer, mortar carrier, and multiple launch rocket system (MLRS) vehicles. Howitzers are modeled as large ballistic guns either towed behind a vehicle or mounted. Mortar carriers are modeled as weapons mounted on armored vehicles. MLRS vehicles are modeled as pods of large rockets mounted on an armored vehicle.

The Fire Support tool uses the following artillery vehicles:

Red:	Blue:
Russian 2S1	US M109
Russian 2S12	US M109A1
Russian 2S19	US M109A3
Russian BM21	US M109A5
Russian 2B11	US M109A6
	US M106A1
	US M1064
	US M102
	US M119
	US M198

The artillery vehicles listed above are configured with the SM_VIFMission task (see the `common/src/ModSAF/entities` directory).

The Fire Support tool uses the following M270 family of blue MLRS vehicles.

```
US M270_GAT2 (has German AT2 mine dispersing
              rockets)
US M270_M26 (has 2 pods of M26 HE rockets)
US M270_M77 (has 2 pods of M77 DPICM rockets)
```

MLRS vehicles are configured with the SM_VMLRS and SM_UMLRS tasks. Before you can assign an MLRS vehicle a fire mission using the Fire Support tool, you must assign it an `MLRS` task frame using the Unit Operations editor (see Section 6.5 [Performing Operations on a Unit], page 56; see Section 7.1 [Setting Up a Single-Phase Mission], page 69). The MLRS task frame gives

the MLRS vehicle a firing point and a hiding point. Without these two points, the MLRS can not fire.

A Fire Direction Center (FDC) translates fire requests into fire orders and sends the orders to its registered artillery guns. The Fire Support tool uses vehicles configured with the SM_VFDC task (see the **common/src/ModSAF/entities** directory) as FDC vehicles. These FDC vehicles include:

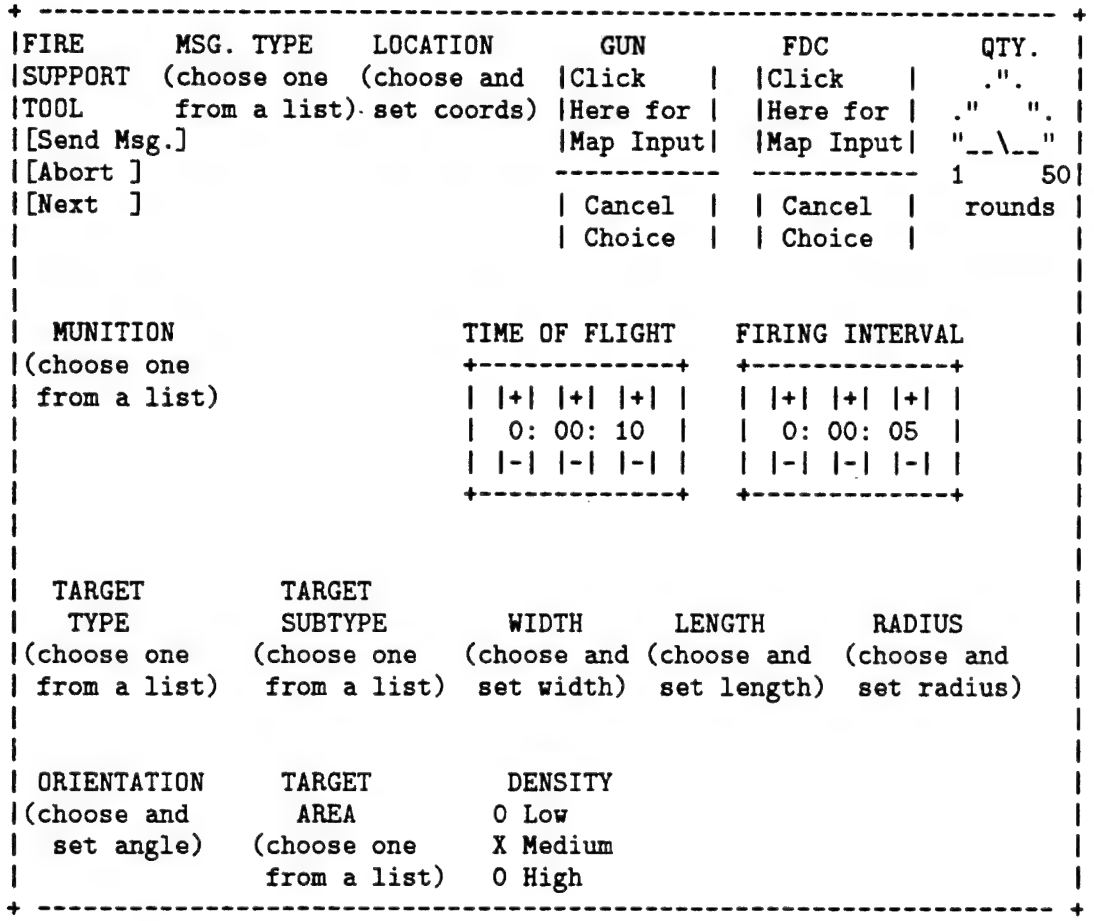
Red:	Blue:
BTR60PU	M113 Observer
ZIL131_FDC	M557A1
1V13	HUMMV
1V14	M35A2_FDC
1V15	
1V16	

Fire requests sent to an FDC vehicle (such as an M113 Observer, M557A1 or ZIL131_FDC) provide target information so that the FDC can determine munition type, number of rounds, and fire pattern. Artillery (howitzers, mortars, or MLRS) vehicles must be registered with an FDC to function (mixed batteries and platoons are not supported).

An artillery unit consists of a number of guns (up to 24) and an FDC. When creating an artillery unit, do not mix vehicles of different categories under an FDC; that is, an FDC should have only howitzers or only mortars or only MLRS vehicles.

The artillery and FDC vehicles listed above are configured to support an artillery radio for the propagation of fire support messages. The parameter files for these vehicles contains an entry labeled SM_ArtyRadio. These parameter files are located in the directory **common/src/ModSAF/entities**.

When you click the Fire Support button. A display similar to the example below appears in the Editor Area.



The types of fire missions that you can execute from the Fire Support tool include fire orders and requests for artillery fire, artillery-delivered minefields, and close air support (CAS). To execute a fire mission, you must send a Fire Message. Registration messages register guns with an FDC vehicle. A gun must be registered with an FDC before you send a Fire Request or Minefield Request message.

The following sections describe how to issue a fire order to an individual gun and how to use an FDC to control multiple artillery pieces.

8.3.1 Creating a Fire Order

The simplest way to execute a fire mission is with a Fire Order message. However, you must, first, create an artillery vehicle from the list described previously (see Section 6.1 [Creating a Unit], page 48).

1. Click on **Fire Order** under **Message Type**.
2. Click in the Map to designate a landing location for the artillery rounds. The location should be within the artillery vehicle's range.
3. Under "Gun", select **Click Here for Map Input**. Click on the artillery vehicle icon in the Map. This sets that vehicle as the one to fire the mission. A label "Gun" (with an arrow) appears next to the vehicle on the Map. If you make a mistake, click **Cancel Choice**.
4. Depending on the vehicle you have chosen to fire the mission, certain parameters can be enabled (munition type, round quantity). You can use the defaults, or set new parameters. The parameter, "Time of Flight", is the time it should take the round to reach the target. The parameter, "Firing Interval", is the amount of time between each shot. To create an artillery-delivered minefield choose the appropriate munition (such as M692, MM731, M718, or M741 for the M109 vehicle).
5. Click **Send Message** when the parameters are complete. The mission fires accordingly. Artillery rounds, on impact, appear on the Map as purple stars.

8.3.2 Creating Registered Artillery Units

To create registered artillery units, you must first create the appropriate vehicles (such as an FDC and several artillery vehicles). Once this has been done, you can register the artillery pieces to the FDC.

Note: Artillery batteries (such as the 2S1 Battery and the M109 Battery) perform automatic registration. If the Message Log is displayed, you will notice that registration confirmation messages appear when these batteries are simulated.

1. Click on **Registration** under **Message Type**.
2. Under "Gun", select **Click Here for Map Input**. Click on the artillery vehicle icon on the Map. A label "Gun" (with an arrow) appears next to the vehicle on the Map. If you make a mistake, click **Cancel Choice**.
3. Under "FDC", select **Click Here for Map Input**. Click on the FDC vehicle icon on the Map. This sets that vehicle as the FDC, and it now knows which artillery vehicle it controls. A label "FDC" with an arrow appears next to the vehicle on the Map. If you make a mistake, click **Cancel Choice**.
4. Click **Next** to send the registration message. This causes the registration message to be sent over the artillery radio, and links this vehicle to your FDC. If the Message Log is displayed, a registration confirmation will appear.

5. Repeat the above registration process (with the exception of specifying the FDC, since the editor repeats the last value assigned and the FDC doesn't change) if you want to register other artillery vehicles with the FDC vehicle.

   Note: The FDC is now capable of processing a Fire Request. To learn more about the parameters and use of a Fire Request, see the next two sections.

8.3.3 Creating a Fire Request

A fire request simulates a message that is usually sent from a Forward Observer (FO) to an FDC requesting artillery (other than an artillery-delivered minefield). The FO sends the FDC as much information about the target as possible, and, in some cases, makes recommendations on the method of engagement. The FDC processes the target information and chooses to accept or modify any recommendations provided by the FO.

An FDC must translate the data it receives in a fire request into fire orders for all its subordinates. The following factors determine the artillery firing methods.

1. Target subtype and/or physical size of the target determine the total number of rounds to be delivered.
2. Target type determines the type of artillery munition; however, you can override it by selecting a munition type in the Fire Support editor.
3. Physical size and shape of the target area determine the firing sheaf type. The following sheafs are available:
   - Point: All guns concentrate fire at a single point.
   - Circular (BCS): Fire is distributed around a radius which is roughly half the size of the target radius. The number of subordinates determines the number of firing points since all guns are used.
   - Rectangular: Fire is distributed at the vertices of uniform squares. The number of squares is determined by the number of guns registered to the FDC.

The fire request is flexible. You can emulate an FO by giving the FDC target information (type, subtype, and size), or you can take full control by specifying the munition and the firing sheaf. You can also choose to specify only the target location and let the FDC choose a default munition and sheaf.

Before sending a fire request, create an FDC vehicle and the artillery vehicle(s). Register the artillery vehicle(s) with the FDC vehicle.

1. Click on **Fire Request** under **Message Type**.
2. Click the Map to designate a target location for the artillery round(s). The location should be within the artillery vehicle's range.
3. Under "FDC", select **Click Here for Map Input**. Click on the FDC vehicle icon on the Map. This sets that vehicle as the FDC, and the FDC knows which artillery vehicle(s) it controls. A label "FDC" appears next to the vehicle on the Map. If you make a mistake, click **Cancel Choice**.
4. Using an FDC lets you specify target parameters, and the system automatically sets the munition type, rate of fire, etc. Choose from the toggles under Target Type, Target Subtype, and Target Area (if known) to set new parameters or use the defaults. Note that if the Target Area is a rectangle, you can specify length and width; if it is a circle, you can specify radius.
5. When you have completed the parameters, click the **Send Message** button. If the Message Log is displayed, "Ready" message(s) will appear when the artillery vehicle(s) are ready to fire, followed by a "Fire" message. Then the mission fires.

8.3.4 Creating an Artillery Delivered Minefield Request

The Minefield fire mission is a fire request through the FDC for an artillery-delivered minefield. Before sending a Fire Request, create an FDC vehicle and the artillery vehicle(s). Then register the artillery vehicle(s) with the FDC vehicle.

Artillery vehicles that support artillery-delivered minefields include an M109 or an M270_GAT2 MLRS vehicle. For the M270_GAT2, you must assign an MLRS task frame with both a firing point and a hiding point and issue the MLRS On Order. An MLRS, responding to a fire order, moves to its fire point, fires, and then moves to its hide point.

1. Click **Minefield** under **Message Type**.
2. Click the Map to designate a minefield location. The location should be within range.
3. You can set density (choose low, medium, or high) and length; you cannot set the width or pattern parameters. The mines land randomly.
4. Under "FDC", select **Click Here for Map Input**. Click on the FDC vehicle icon on the Map. This sets that vehicle as the one to control the mission. A label, "FDC", appears next to the vehicle on the Map.
5. When the parameters are complete, click **Send Message**. The mission fires accordingly. A "Minefield" label and a group of dots appear on the Map.

8.3.5 Creating a Close Air Support (CAS) Request

You can call in CAS to A10 aircraft. Before an A10 can perform CAS, you must give it a CAS Mission task frame with both a route and a refuel point and issue the CAS Mission On Order. At any point during the aircraft's flight you can use the Fire Support editor to call in a CAS mission.

1. Click **Air Support** under **Message Type**.
2. Under "Gun", select **Click Here for Map Input**. Click an icon in the Map that represents an FWA that is executing the Close-Air-Support task. This sets that vehicle as the one to perform the CAS mission. A label "Gun" appears next to the vehicle on the Map.
3. Click the Map in close proximity to the enemy to designate an attack location.
4. When the parameters are complete, click **Send Message**. The mission fires accordingly and the FWA attack the enemy at the target location.

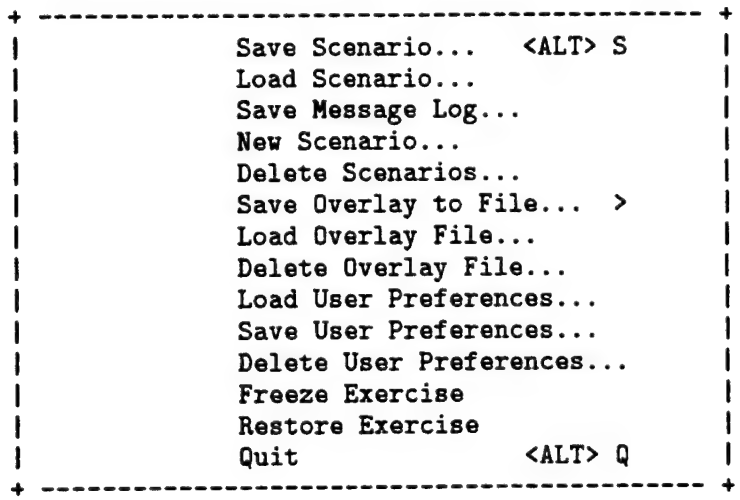
9 Miscellaneous Commands

This sections describe commands that are located in pulldown menus that display when you click on a command in the Menu Bar at the top of the screen. One way you can issue these commands is to hold/Left on a Menu Bar item, drag/Left to the desired command, then release to select that command. To remove a pulldown command menu from the screen without selecting one of its choices, click any part of the terrain in the Map.

Some of the command menus are discussed in previous sections (Map Scale, Map Features, HHours, Privilege, and On Order). The other command menus (File, Show As, Local Force, and Special) are described in the following sections.

9.1 Using the File Commands

You access the File pulldown menu from the Menu Bar. This menu lets you perform operations on scenarios, the message log, overlays, and user preference settings. You can temporarily freeze an exercise or exit ModSAF from this menu. All File commands are enabled at the SysOp privilege level (the other privilege permissions are noted below). The File pulldown menu is shown below.



ModSAF reports errors on file operations using a pop-up display. The SAFstations beep when reporting these errors. The following sections describe the File commands in more detail.

- Save Scenario - You can save a scenario (containing an exercise's units, graphic overlays, and tasking) in a disk file at any time in an exercise. A pop-up display requests a name for the scenario disk file. Click a name from the list offered to create a newer version of an existing file, or type a name. A valid name is one alphanumeric word; don't use spaces or periods in the name.

  A separate scenarios directory (../../scenarios) stores the scenarios; you can override the default scenario directory with the `-scenario` command line option.

- Load Scenario - You can load a scenario disk file to restart an exercise at the point that it was saved. To prevent multiple objects from appearing at the same location, an overlay retrieved from disk cannot have the same name as an overlay in memory. However, by placing scenario objects on a uniquely named overlay or changing the name of any overlay in memory whose name is the same as your disk file overlay (for example, the Unnamed overlay), you can bypass this constraint. Note: This command is not enabled at the Operator and Commander privilege levels.

  When loading scenarios, the SAFSIMs are automatically frozen until all the vehicles have been created. You are presented with dialog windows describing the progress of the scenario load. You can dismiss the dialogs if anything goes wrong (for example, no simulators available).

- Save Message Log - You can save data in the Message Log in a disk file for review. A pop-up display requests a name for the log disk file. Click a name from the list offered to create a newer version of an existing file, or else type a name. A valid name is one alphanumeric word; don't use spaces or periods in the name.

  A separate log directory (../../logs) stores the Message Log. See Section 9.4 [Special Subcommands], page 94.

- New Scenario - This command deletes all objects running on the same PO database, even those created on other SAFstations. Deleted objects are removed from both the Map and the simulation. Note: This command is not enabled at the Operator and Commander privilege level.

- Delete Scenarios - A pop-up display shows you the names of the existing scenario files. To delete a file, click its name in the list or type its path name in the Selection box. (If you want to exit without deleting, select `Done` without naming a file.) Note: This command is enabled at the SysOp privilege level only.

- Save Overlay to File - You can save an overlay in memory in a disk file for reuse of its graphics. A pop-up display requests a name for the overlay disk file. Click a name from the list or type in a name. A valid name is one alphanumeric word; don't use spaces or periods in the name.

  A separate overlays directory (../../overlays) stores the overlays. You can override the default overlay directory with the `-overlay` command line option.

- Load Overlay File - You can load an overlay disk file to reuse its graphics. To prevent multiple objects from appearing at the same, an overlay retrieved from disk cannot have the same name as an overlay in memory. However, you can change the name of any overlay in memory whose

name is the same as your disk file overlay (for example, the Unnamed overlay) to bypass this constraint. Note: This command is not enabled at the Operator and Commander privilege levels.

- Delete Overlay File - A pop-up display shows you the names of the existing overlay files. To delete a file, click its name in the list or type its path name in the Selection box. (If you want to exit without deleting, select **Done** without naming a file.) Note: This command is enabled at the SysOp privilege level only.
- Load User Preferences - You can load a disk file of the SAFstation user preference settings to set the SAFstation to those saved settings. A pop-up display requests a name for the disk file. Click on a name from the list offered or else type in a path name.
- Save User Preferences - You can save a set of SAFstation user preferences in a disk file. A pop-up display requests a name for the disk file. Click a name from the list offered to create a newer version of an existing file, or type in a name. A valid name is one alphanumeric word; don't use spaces or periods in the name.

  A separate directory (../../profiles) stores the user preferences file. You can override the default preferences directory with the **-profile** command line option.
- Delete User Preferences - A pop-up display shows you the names of the existing user preference files. To delete a file, click its name in the list or type its name in the Selection box. If you want to exit without deleting, select **Done** without naming a file. Note: This command is enabled at the SysOp privilege level only.
- Freeze Exercise - DIS protocol version 2.0.3 (-dis -version 3) supports special PDUs that can freeze or resume an exercise. The DIS203 Freeze, Resume, and Ack PDUS are also available in other protocols. In DIS 1.0, these show up as new PDU types (the kind values 13,14,15 were not used in 1.0). In SIMNET, these show up as protocol family 3 (the experimental number for DIS PDUs when using SIMNET protocols). ModSAF supports these PDUs so that all ModSAF simulators in an exercise can be stopped and started simultaneously. Other DIS applications on the network may support these PDUs as well, but that is not guaranteed. To freeze the simulation (including ModSAF simulations using different PO databases), use the **Freeze Exercise** command. This command requires Battlemaster privilege level. You can still interact with ModSAF units while they are frozen but the simulated vehicles will not move or shoot.

  You might want to freeze an exercise when the exercise is composed of multiple scenarios. In this case, the battlemaster can do the following:

  ```
  1) Freeze Exercise
  2) Load first scenario
  3) Load second scenario
  ...
  4) Resume Exercise
  ```
- Restore Exercise - This command resumes the frozen simulation. Restarting a stopped exercise requires Battlemaster privilege level.

- Quit - This command stops the SAFstation program. You can also use <ALT> Q (hold down "ALT" key and type "Q"). Wait at least 45 seconds before restarting. Note: This command is enabled at the SysOp privilege level only.

9.2 Using the Show As Command

You use the **Show As** command (on the Menu Bar) to change the appearance of icons in the Map and the current level of command. This enables a unit to be shown (or commanded) at one of its corresponding hierarchical levels. For example, a platoon can be commanded as a platoon or as the several individual vehicles that make up the platoon.

You can reduce the computational burden of displaying large exercises by showing icons at a higher level.

The choices in the **Show As** menu are:

- Vehicle Pictures
- Vehicle Icons
- Platoon Icons
- Company Icons

The Map displays vehicle pictures or vehicle, platoon, or company icons for units that match the local force settings or for units that are commanded by the SAFstation. In addition, the Map displays vehicle picture or icons (but not platoon or company icons) for units that are detected by the commanded units.

Example: A SAFstation at Commander privilege level has its **Local Force** set to friendly. Suppose there is a friendly platoon and an enemy platoon visible to each other with the enemy commanded by another SAFstation. The following displays on the Map when **Show As** is set to:

- Vehicle Pictures or Vehicle Icons: Both platoons are displayed because the commanded friendly platoon can see the enemy vehicles.
- Platoon Icons or Company Icons: Only the friendly platoon is displayed because it is a commanded unit. Detected units do not display the way that detected vehicles do.

9.3 Using the Local Force Command

ModSAF uses a SAFstation's local force and privilege setting, plus a unit's "commanded by" setting to determine what appears in the Map, the Icon strip, and the Message Log. Typically, the local force is friendly, enemy, or both. If the local force is neither friendly nor enemy, then the local force criteria is ignored when ModSAF determines what to display where.

You can set the SAFstation alignment in SysOp or Battlemaster privilege. See Chapter 4 [The Tactical Map View], page 25. Changing local force or privilege on a SAFstation impacts only that SAFstation; it doesn't impact what displays on other SAFstations.

The Map shows the commander's units, and what those units believe about enemy organization. It also displays vehicle pictures and icons for units that match the SAFstation's local force setting, units that are commanded by the SAFstation, or units that are spotted by the SAFstation's commanded units. Note: Platoon or company icons (chosen with the "Show As" command) show units that match the local force setting or units that are commanded by the SAFstation only. They do not show units that are spotted by the SAFstation's commanded units.

Example: Assume an exercise has two SAFstations (A, B) and each SAFstation is set to Commander privilege. The friendly forces are commanded by A and the enemy are commanded by B.

Setting A's local force to friendly, enemy, or both, means that ModSAF determines which units are shown on A by examining both the local force and the commanded by criteria. The following descriptions apply depending on the local force setting:

- When local force is friendly, the Map shows friendly units plus any enemy units commanded by the SAFstation. It also displays the enemy vehicles (not units) that the SAFstation-commanded units can see.
- When local force is enemy, the SAFstation shows enemy units plus any friendly units commanded by the SAFstation. It also displays the friendly vehicles (not units) that the SAFstation-commanded units can see.
- When local force is both friendly and enemy, the SAFstation shows any friendly or enemy units.

When local force is cleared (neither friendly nor enemy selected), ModSAF shows units using the commanded-by criteria only. Therefore, the 'A" SAFstation commander would only see A-commanded units and the enemy vehicles (not units) that those commanded units could see.

When the SAFstation is in Commander privilege level, unit icons in the Icon Strip display for units that are commanded by this SAFstation only. In Battlemaster privilege level, unit icons are displayed for units that match the SAFstation's local force setting or are commanded by this SAFstation.

Radio messages (in the Message Log) display for units that match the local force setting, or units that are commanded by the SAFstation.

9.4 Using the Special Commands

ModSAF provides a **Special Commands** pulldown menu. Its choices are:

1. Show Messages - The Message Log shows messages that simulate those that forces in the field might send by radio to their command center. When the Message Log is displayed, it appears in a rectangular area at the right of the Map (it does obscure part of the Map). Radio messages appear for units that match the local force setting, or for units that are commanded by this SAFstation.

   The **Show Messages** command is a toggle that controls the showing and hiding of the Message Log. To change the display setting, click the command. When the command is preceded by a recessed toggle button, the display setting is on.
2. Show Editor - The SAFstation displays various editors in the Editor Area. This area, when displayed, appears beneath the Map (it obscure part of the Map).

   The **Show Editor** command is a toggle that controls the showing and hiding of the Editor Area. To change the display setting, click the command. When the command is preceded by a recessed toggle button, the display setting is on. (You can also change the display status with ALT <E> (hold down the "ALT" key and then type "E")).
3. Clear Messages - Select **Clear Messages** to erase the contents of the Message Log.
4. Freeze Display - The Map constantly redrawns to reflect the current locations of battlefield entities. When the **Freeze Display** toggle is set to on, the redraw is stopped. To restart, change the toggle setting to off.

10 Miscellaneous Editors

This chapter describes editors that handle setting default units of measurement (User Preferences), configuring the Map display (PVD Controls), controlling the Stealth vehicle (Stealth Controls), and editing overlays (Overlay Editor).

When you access these editors, the settings in the editor reflect those made in the previous interaction; they do not reset to their original values.

10.1 Setting User Preferences

The User Preference editor sets measurement defaults. You can save these defaults on a disk for reuse. See Section 9.4 [Special Subcommands], page 94, for instructions.

1. Click **User Preferences** (first red button on the left in the Button Column). A display similar to the one below appears in the Editor Area.

```
+ ------------------------------------------------------------------ +
|   USER      COORDINATE   UTM       SPEEDS          ANGLES    DISTANCES |
|PREFERENCES  SYSTEM    PRECISION  0 Meter/Sec   0 Degrees   0 Meters  |
| [ Done ]  0 X/Y (TCC)  0  4      X Km/Hour     X Mils      X KM      |
| [Revert]  0 Lat/Long   0  6      0 Feet/Sec    0 Compass   0 Feet    |
| [Abort ]  X UTM        0  8      0 Mile/Hour               0 Miles   |
| [Save as               X 10      0 Knots                   0 NM      |
| Default]                         0 Mach                              |
|                                                                      |
|  ALTITUDES      FUEL         LINE EDITING                 CONTOURS    |
| X  Meters    0  Liters          MODE                      0 Variable  |
| 0  KM        X  Gallons     X Parts                       X Fixed     |
| 0  Feet      0  Pounds      0 Whole                                   |
| 0  Miles                                                             |
| 0  K Feet                                                            |
|                                                                      |
|ALTITUDES           ZOOM SCALES          MAP SCROLL BARS              |
| ON MAP           X  Any Scale       0  Top Right    0  Top Left     |
|X Hundreds of ft  0  Only Standard   0  Bottom Left  0  Bottom Right |
|0 Preferred Units                    X  Do Not Display               |
|                                                                      |
| TIME FORMAT                            EDITOR WINDOW DISPLAY         |
|X Local Time                         X  Show Editor in Select Mode    |
|0 GMT (UTC)                          0  Hide Editor in Select Mode    |
+ ------------------------------------------------------------------ +
```

2. Click an "only-one-on toggle" box to set a default choice for the SAFstation. The choices include:

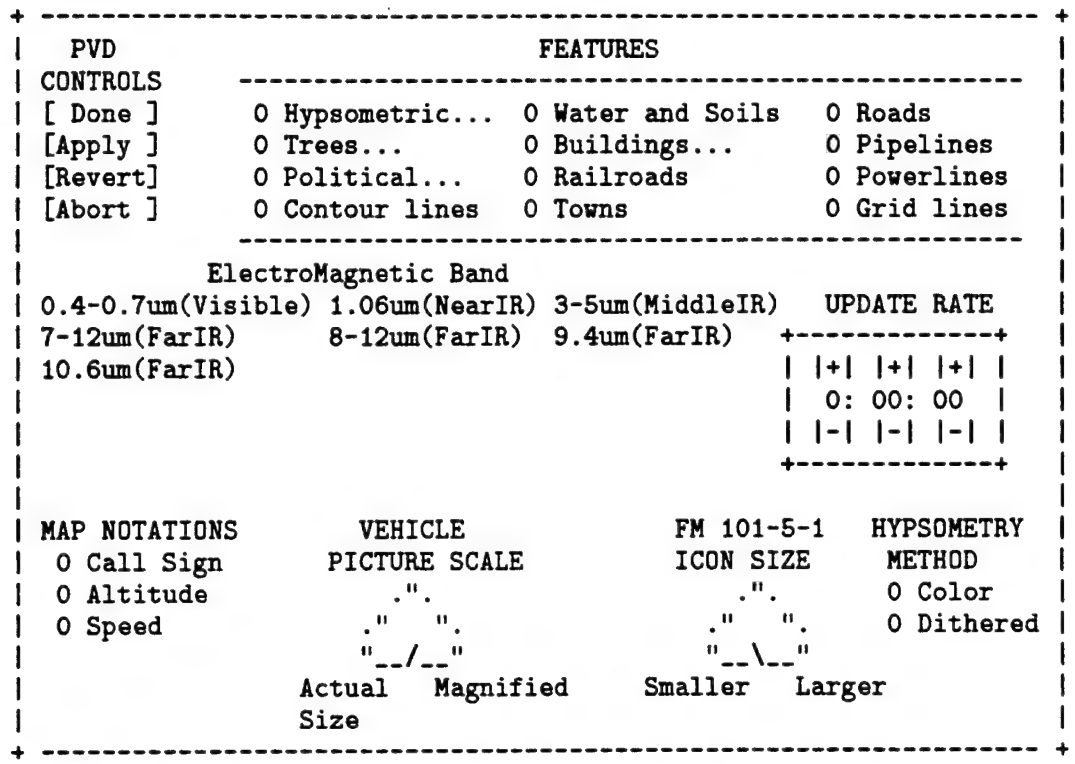
- Select Line Editing Mode to choose which parts of a line will become "mouse sensitive" when you click it (the whole line, or each segment individually).
- Time Format applies to the clock at the right of the Menu Bar.
- When the Zoom Scales toggle is set to **Any Scale**, zooming in around an area displays the selected area without forcing the use of one of the standard scales.
- You can choose whether and where to display horizontal and vertical Map Scroll Bars.
- You can choose whether to show or hide the Editor Area when the SAFstation is in a Select rather than Editor button mode.
- There is a user preference value for the number of UTM digits of precision (4, 6, 8, or 10).
- There is a user preference value for "Fixed Contours". If selected, contour intervals do not automatically change with map scale, and an editable becomes available in the PVD editor to select a contour interval (default: 100 meters). Any interval from 1 to 1000 may be entered.

3. Select a button from the upper left corner of the editor.
   - Click **Done** when the display is set and you want to save it.
   - Click **Revert** at any time to undo any of your changes.
   - Click **Abort** to exit and ignore any changes.
   - Click **Save as Default** when the display is set and you want the system to make the current settings in the editor your default settings (determined by $HOME directory). These settings are saved in the file named .modsaf_pref.

10.2 Setting Screen Display Options

The Plan View Display (PVD) Controls editor sets screen display defaults.

1. Click **PVD Controls** (second red button on the left). A menu similar to the one below appears.



2. You can make changes to set Map display options. The choices include:
   - To change display status of a terrain feature, click its toggle box. A toggle box appears recessed if its associated terrain feature is set to display.
   - To set the vehicle picture scale, used in the Map display of vehicle pictures, move the dial indicator (pointer). As the indicator moves to the left, the vehicle picture shrinks to actual size relative to the Map zoom scale. As the indicator moves to the right, the vehicle picture enlarges.
   - To set the icon size scale, used in the Map display of military icons, move the dial indicator. As the indicator moves to the left, the icon display shrinks. As the indicator moves to the right side, the icon display enlarges.
   - To select a Hypsometry Method, click on its toggle box. It can be either "Color" or "Dithered".
   - To show a vehicle's label, speed, and/or altitude on the Map, click the corresponding Map Notations toggle box to on. When set to display, the Call Sign appears as a label on the vehicle's left. Altitude displays on the vehicle's lower left, and speed displays on the vehicle's lower right. When displayed, speed and altitude use units specified in the User Preference settings.
   - Click the hour, minute, or second arrows to change the rate between screen updates. The rate can vary from 0 to 30 seconds. (An alternate way to change the rate is by typing a new rate.) A rate of "0:00:00" means update as fast as possible. A change to a rate of

1 or 2 seconds can speed up zoom and pan operations and can reduce the computational burden of displaying large exercises.

- The ElectroMagnetic Band setting has no effect since smoke is not modeled. If smoke were modeled, you could click on a toggle box to choose a bandwidth setting.

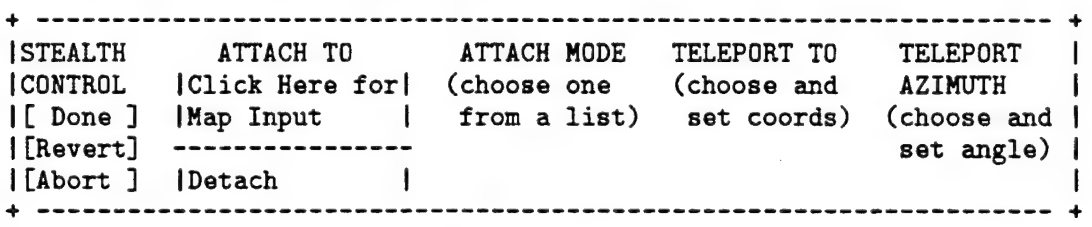
3. Select a button from the upper left corner of the editor.
   - Click **Revert** to return to original settings
   - Click **Apply** to see how the Map will appear with the new settings.
   - Click **Done** to make the changes and exit.
   - Click **Abort** to ignore any changes and exit the PVD Controls editor.

10.3 Controlling the Stealth Vehicle

Although a Stealth vehicle (sometimes referred to as the "flying carpet") is not a ModSAF component, it can be present on the network to present a three-dimensional view of the simulated battlefield. The Stealth Control editor lets you perform the Stealth attach or teleport operation, and change the attach mode.

1. There are two ways to access the Stealth Control editor:
   - Click **Stealth Controls** (the button marked with a red arrow).
   - Move the mouse pointer to a Stealth symbol (a large arrow) on the Map. The symbol highlights with an outline box to show its selection. Click to access the Stealth Control editor.

   The figure below shows a sample Stealth Control editor.



2. To select a stealth vehicle to control, click on the (Stealth/Preview) **Click Here for Map Input** button and then click on a stealth object in the Map.
3. To select a vehicle to attach to, click on the (Attach To) **Click Here for Map Input** button and then click on a vehicle in the Map. Attachment enables the Stealth to become "latched onto" a vehicle, and allows the Stealth to follow a vehicle without operator effort.
4. To change the Attach Mode, select a new value from the Attach Mode list. Attach the Stealth to a target vehicle before assigning one of the attach modes. The Stealth automatically exits an attach mode if its target vehicle no longer exists.

The following attach modes are available:

- Tether Attach - The Stealth is attached to a vehicle at a certain distance and bearing. The Stealth moves with the vehicle, changing its speed and direction as the vehicle does. Moving the Stealth's spaceball allows the Stealth to free fly relative to the vehicle, not the terrain.
- Compass Attach - The Stealth is attached to a vehicle at a certain distance and bearing. The Stealth moves with the vehicle, changing its speed as the vehicle does. However, the Stealth will not change its direction. It remains facing the same direction even if the vehicle turns. Moving the Stealth's spaceball allows the Stealth to free fly around the vehicle.
- Orbit Attach - The Stealth is attached to a vehicle at its center of mass. The Stealth always moves with the vehicle. The Stealth's spaceball movements allow the Stealth to spherically travel around the vehicle which remains in the center.
- Mimic Attach - The Stealth becomes imbedded with the target vehicle, inheriting all components of velocity and orientation. The spaceball movements allow the Stealth to slew its view up and down and to rotate around the Z axis of the target vehicle to facilitate viewing in all possible directions.

5. To move the Stealth to another battlefield area, click a Teleport Coordinate box and then click in the Map to set a teleport location. To change the Teleport Azimuth, edit the angular value. When teleported, the Stealth will be at the selected location and will move with the dynamics of an aircraft. The Stealth's spaceball movements allow the Stealth to free fly around the terrain.

   Select a button from the upper left corner of the editor.

   - Click **Done** to accept the edits and exit.
   - Click **Revert** to return to the original settings without exiting.
   - Click **Abort** to exit ignoring any changes.

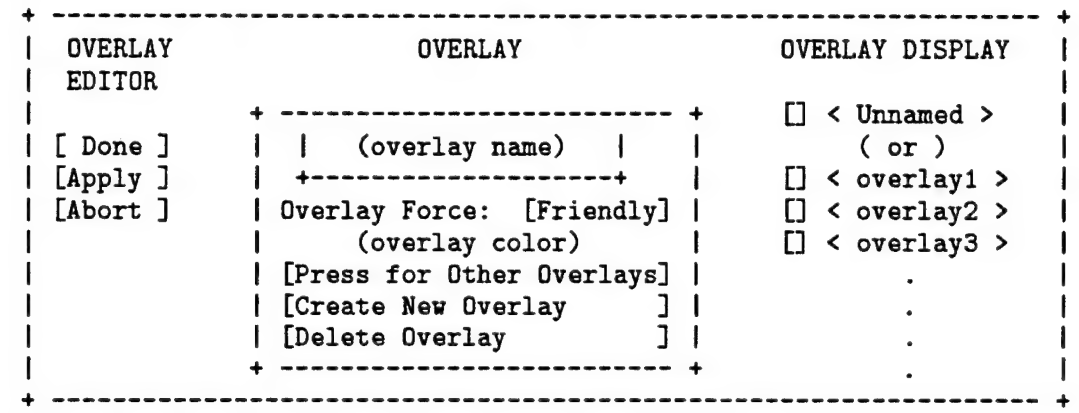
10.4 Editing an Overlay

An overlay can contain graphics (such as routes, battle position lines, And phase lines) needed to perform a mission.

The Overlay editor lets you create, edit, display, and delete overlays. You can change the overlay name, select a different overlay as the current overlay, create a new overlay, or change the display setting of an overlay.

The SAFstation automatically displays overlays that are created on it. (It does not automatically display overlays that are created on other SAFstations. Overlays, created on other SAFstations with the same PO database and local force setting, will display if their display setting is set ON in the Overlay Display list of the Overlay editor.)

1. Click the **Overlay Editor** button (fourth red button on the right) to access the Overlay editor. A display similar to the following example appears in the Editor Area. The Current Editor Help line displays some of the overlay editing operations.



You can make changes to set overlay options. The choices include:

- To change the current overlay name, edit the text in the overlay name box.
- To change the alignment of the current overlay, hold/Left on the current Overlay Force value and select a new value from the displayed list.
- To change the color of the current overlay, hold/Left on the current Color value and select a new value from the displayed list.
- To create a new overlay, click the **Create New Overlay** button and type a name in the overlay name field.
- To delete an overlay, click the **Delete Overlay** button. A pop-up confirmation display appears asking whether you want to delete the current overlay. Click the **Delete** button to confirm, or the **Don't Delete** button to avoid deletion.
- To change the display setting of an overlay, click its name in the Overlay Display list.

2. Select a button from the upper left corner of the editor.
   - Click **Done** to have the changes apply and then exit.
   - Click **Apply** to have the changes apply without exiting.
   - Click **Abort** to ignore any changes and exit the editor.

11 Additional Capabilities

This chapter describes some of the special systems and models which have been added to ModSAF.

11.1 Ivis Support

ModSAF vehicles, when configured to support the DIS or SIMNET Combat Vehicle Command and Control (CVCC) Ivis protocol, send identity and location information as appropriate to establish connectivity and provide mutual PosNav data.

For CVCC IVIS, Status Info messages are sent every five seconds and Mapping Control messages are sent every sixty seconds. These messages support the mutual POSNAV aspect of IVIS, and contain location and identity information, including duty position and call sign.

For DIS IVIS, the ID_Report and Respond_To_New_Node messages are sent as necessary. Position_Location messages are sent every 20 seconds, or when the vehicle travels more than 500 meters.

To determine the identity information, ModSAF uses the vehicle's bumper number (marking). For example: if the marking is A23, that vehicle is considered to be on the A2 network and is placed as the wingman in the second platoon of A company. Likewise, vehicle A21 is the platoon leader of the second platoon of A company, and is on the A company network. Note that this vehicle is not also on the platoon network.

Because the duty position and network information is essential in IVIS reporting, a marking with at least one alpha character, followed by at least two non-space characters is required. The alpha character need not be the first character.

For DIS IVIS, the radio parameters for each tactical network are contained in a parameter file. These parameters must match those used by other IVIS devices on the same tactical networks.

ModSAF units can also issue Contact, Spot, and Call For Fire Reports. You need not perform any operator action to determine which messages display. The IVIS messages are generated by ModSAF tasks, so messages are not sent until the vehicle is assigned the appropriate task.

ModSAF uses the externally-supplied library named LibIvis to support DIS IVIS devices, including the CAC2 device. Initially, LibIvis was extracted from the General Dynamics M1A2 manned simulator and adapted for external use by the NASA IVIS Emulator. It was later adapted for use by the CAC2 device on the DIS network.

LibIvis was originally designed to support a single vehicle and made extensive use of external variables for data storage. Since ModSAF functionality requires support of many vehicles simultaneously, these external variables have been stored in the interface library LibIvisI.

11.2 Concealed Routes

ModSAF can find concealed routes with respect to enemy locations during bounding overwatch maneuvers. The ModSAF concealed-route algorithm uses the terrain database to obtain terrain elevation and feature information. The algorithm makes use of two independent components: the concealment-map generator and the concealed-route planner.

The concealment-map generator uses terrain reasoning to compute concealed areas. Its input is a list of "enemy descriptors" which describe a unit's enemies. Descriptor information can include the following:

direction - when it is known that the enemy is in a certain direction

area - when it is known that the enemies are located or are maneuvering in a particular area

location - when the actual location of an enemy is known.

The concealment-map generator output is a series of concealed-area polygons, referred to as the "concealment map". ModSAF computes the contribution of each enemy descriptor to the concealment map separately and uses the intersection data of each contribution to generate the final concealment map.

The concealed-route planner takes a concealment map, a source point, and a goal point as its input. It constructs a graph whose nodes are the concealed regions produced by the concealment-map generator. ModSAF automatically and efficiently determines which nodes should be disregarded and which pairs of nodes (concealed regions) should be linked in a progression toward the goal point. ModSAF then finds an optimal path through the concealment-map space from the source point to the goal point. An optimal path is one which has the smallest ratio of exposed distance to total distance.

11.3 Simulator Activation

ModSAF 1.5 adds SIMNET simulator activation/deactivation capability to the SAFstation graphical user interface (GUI). This capability, which is only applicable to a SIMNET exercise, uses two editors: an Exercise editor and a Simulator editor. You use the Exercise editor to describe the exercise, identifying the exercise mode and the participating simulators (only M1, M2, or M3 simulators can be activated from a SAFstation). You use the Simulator editor to supply activation parameters to each simulator.

The Simulator Activation tool is controlled by a runtime switch which applies only when you are using SIMNET packets. If you are using DIS packets, a button for the Simulator Activation tool does not appear on the SAFstation. Simulator activation is on, by default, when running with SIMNET packets.

See the ModSAF library, '`libsimedt`', for more information.

11.3.1 Exercise Editor

When ModSAF is run using the SIMNET protocol, a tool button labeled SIM appears on the SAFstation GUI. When you select this button, an Exercise editor containing the following items displays in the Editor Area at the bottom of the SAFstation screen:

- Simulator List – A selectable, scrollable list of simulators that can be activated from this ModSAF station. Each item in the list contains the local ID of the simulator, simulator type (M1, M2 or M3), assigned Company (A-I), bumper number, and location (if the simulator has been placed). With the exception of location, the displayed information is derived from a user-modifiable reader file, '`sims.rdr`', which resides in the .../common/data directory.
- Exercise Mode – A new Menu Bar item, Force Designation, appears at the top of the GUI to let you set the mode for a SIMNET exercise. This setting determines how each force sees its own vehicles and how it sees opposing vehicles.
  - `Friendly vs Enemy` – This corresponds to an exercise in which a force of simulated US vehicles opposes a force of simulated Soviet vehicles. For example, two vehicles playing on the Friendly side could view each other as brown, friendly, US vehicles and they could view Enemy side vehicles as green, enemy, Soviet vehicles. Similarly, two vehicles playing on the Enemy side could view each other as green Soviet vehicles and view their opponents as brown US vehicles. This is sometimes called "absolute" mode.
  - `Own as Friendly, Opponents as Enemy` – This corresponds to an exercise of two forces with each force viewing themselves as US vehicles and their opponents as Soviet vehicles

(manned simulators, regardless of whether they play on the offense or defense, view opponents with an enemy shape and in the same green enemy color). This is sometimes called "relative" mode.

- Company Selection – A set of choices lets you manipulate the simulator list. You can display a list of all simulators or only those allocated to a particular company by selecting the appropriate company. The choices are mutually exclusive.
- Done Button – When you select this button, the Exercise editor is closed.
- Edit Button – This button is activated when you select a simulator from the list. When you click the Edit button, a Simulator editor for the selected simulator appears. Procedures for entering data with this Simulator editor are similar to those used when entering data with the ModSAF Unit Editor.

11.3.2 Simulator Editor

A Simulator Editor contains the following fields:

- Label – Describes the simulator that this editor applies to (i.e. the local simulator number, simulator type, and company affiliation).
- Bumper Number – Lets you modify the simulator's bumper number.
- Location – Lets you select a point on the map or manually enter coordinates to supply a location where the simulator is to be activated.
- Bow Direction – Lets you define the hull direction at initialization.
- Side – Lets you select either Friendly, Enemy, or Observer. Selecting any one of these mutually exclusive fields defines the guise of the simulator.
- Company Allocation – Lists letters A through I. Select a letter to allocate the simulator to the company.
- Maintenance Status – Contains several maintenance status choices: New, 1, 2, 3, 4 and Old. Select a value to define the age of the simulator.
- Status Shown – Contains three values: Default, Initial and Current. When you select Default, default values for the simulator (read in from '`sims.rdr`') display. When you select Initial, the parameters with which the simulator was last activated display. When you select Current, the simulator's current activation values display. Note: If a set of values is not available, the default values display.
- Munition Values – Sets munition values that operate exactly as the fuel and ammo setting fields in the Unit Editor.
- Abort – Lets you exit the Simulator Editor without applying changes.

- Done – Sends an activation packet onto the SIMNET network. The previous Exercise editor reappears.
- Revert – Reverts, or undoes, the last change.

Note: If the simulator is active, a Deactivate Button will be active also. If you select the Deactivate Button, a deactivation packet is sent onto the SIMNET network (after user confirmation).

11.4 UAV Vehicle

A UAV vehicle is a remotely operated reconnaissance FWA that sends out spot reports of enemy positions at given intervals.

The UAV vehicle can perform a Sweep, CAP, or Return to Base mission. This vehicle runs a background task (VFWASpotReport) that sends spot reports over given intervals. (The given interval will be a period of time specified in the task's parametric data; currently the interval period is set at 60 seconds).

The UAV vehicle does not attack enemy vehicles; however it can suffer combat damage.

See the library, `libvfwaspotrep`, for additional information.

11.5 Autonomous Hellfire

RWA Autonomous Hellfire implements a self-designating laser-based Hellfire. This implementation works for any RWA with Hellfire missiles and a laser designator.

The following tasks implement RWA autonomous Hellfire:

- LibURWAHellfire – a unit level autonomous hellfire missile firing task (also referred to as SM_URWAHellfire). When this task is started, it simply checks its unit members and spawns vehicle hellfire tasks for its member vehicles. after the vehicle tasks are spawned, the unit hellfire task (SM_URWAHellfire) monitors any laser code change from the initial assignment. If there is such a change, then the unit task propagates the new laser code to its member vehicles.

- Libvhellfire – a vehicle level task that handles autonomous hellfire missile shooting (also referred to as SM_VHellfire). Autonomous shooting means that laser designation and hellfire missile shooting is done by the same vehicle.

To view RWA Autonomous Hellfire, follow these steps:

1. Find a place on the database where there is a ridge or a hill.
2. Place a T80 platoon on one side of the hill or ridge. Give it hold fire with the ROE editor.
3. Place a AH64 pair on the other side of the hill or ridge about 1 - 2 km away from the T80 platoon. The RWA should not be able to see the T80s and visa-versa.
4. Turn on the altitude PVD display and set the USER PREFERENCE for altitude to be AGL.
5. Show the Message Log.
6. Assign the RWA an RWA Attack on the T80 platoon.
7. After giving the on-order, you should see the following:

```
a.) the two RWA vehicles will move toward the T80s and occupy position.
b.) Once they get there, the Message Log will display a message
    saying that the designator has secured the position.
c.) One of the RWA's will popup and acquire the target and shoot
    hellfire missiles.  NOTE: after RWA use up all hellfire missiles,
    they will start to shoot other munitions to attack the target.
```

11.6 RWA Mobility and Firepower Damage

ModSAF 1.5 handles mobility and firepower kills for RWA vehicles.

An RWA vehicle with a mobility kill performs a forced landing. This means that it searches the area around its present position to look for a safe landing spot (a place where there are no trees, buildings, canopy, bad soil types (such as deep water or rocky ground), steep slopes, or other friendly vehicles, and where the vehicle is concealed from known enemy sites). While the vehicle is waiting for the search for a safe landing spot to complete, it heads for a site that is its farthest reachable position along its heading. This position is determined by multiplying the vehicle's altitude by its best glide scope ratio. If the altitude of the vehicle is at a critical height, where there is no time to do a search, then this position becomes the vehicle's landing site. If, while searching for a good landing site, the vehicle reaches this critical altitude then it picks a site from whatever it has to chose from and lands there (otherwise it lands at the predetermined position). When the search is completed, the vehicle picks the best possible site that is farthest away from the enemy (if there is enemy present) and lands there.

An RWA vehicle with a firepower kill performs a mission abort. If the RWA is performing a mission then the mission abort position is the unit FARP location. Otherwise, such at vehicle creation time, the vehicle's current position is used for the mission abort position. If, for some unusual reason, the mission abort position is deleted, then the last known mission abort position is used. When the vehicle gets close to the mission abort position, it checks whether the position is clear for a landing. If the position is occupied, the RWA uses a nearby spot.If, while performing the mission abort, the vehicle sustains a mobility kill then it stops the mission abort and performs a forced landing.

To view RWA damage handling, do the following:

1. Create RWA vehicles and give them a mission that allows them to fly by enemy vehicles. Turn off all RWA reactions so that the RWA will fly blindly into enemy areas.
2. Observe the RWA behavior. If an RWA vehicle sustains a firepower kill it should turn and fly towards its mission abort position. If an RWA vehicle sustains a mobility kill then it should try to land in a safe location.

11.7 Nap Of Earth Flying

Nap of earth (NOE) flying mode lets an a RWA's route use possible concealed (from enemy) areas. These concealed areas are the shadow areas of tree canopies or tree lines. A NOE target reference point (TRP), which can be entered through the Fly Route task editor, determines the enemy direction. If any enemy vehicle are present, the enemy center position is also used during the generation of the concealed area. If you do not enter a NOE TRP or there is no enemy present, the route goal point is used to indicate an enemy direction.

To view the nap of earth flying, do the following:

1. Create an AH64 vehicle near tree canopies.
2. Assign it an RWA Fly Route with NOE mode, giving it a destination point and a NOE TRP.
3. Give the on-order. The RWA takes off and then a blue route appears. This is the concealed route which uses the shadow area of the tree canopies.

11.8 Environmental Extensions

By default, ModSAF's environmental architecture uses a constant model that simulates an exercise running on a clear sunny day. This means that environmental parameters (such as temperature, ambient light, and wind direction) don't vary during the exercise. When ModSAF is run in this typical way, the list of environmental models that displays when ModSAF boots up shows environmental parameters that are all constants.

To allow ModSAF's environmental architecture to make use of varying models, ModSAF must be run with the -allow_env option. When ModSAF is run with this special -allow_env option, smoke and flare entities are simulated. These entities can transmit special case environmental packets on the network. Smoke entities, resulting from a burning vehicle or from launched smoke grenades, degrade visibility. Smoke and flares, used in combination with a vehicle configured with a signal detection task, can be used for phase transition in a ModSAF mission.

For more information on environmental extensions, see Chapter 14 [Dynamic Virtual Worlds Enhancements], page 123.

12 ModSAF Configuration

A ModSAF exercise can be configured in a variety of ways to make optimal use of hardware. The configuration of a ModSAF installation consists of two separate configuration procedures: computer configuration and network configuration. These two configuration steps are done together when starting the ModSAF programs, but they are logically independent.

12.1 Computer Configuration

ModSAF has three components:

- SAFstation - the graphical user interface (GUI)
- SAFsim - the SAF simulator
- Logger - the exercise recorder

You can configure the ModSAF components in a variety of ways since the recommended ModSAF hardware can run any component. The software is currently organized into two computer programs: a modsaf program and a logger program. The modsaf program contains the SAFstation and the SAFsim linked together into one executable. A computer can run either the modsaf program or the logger program, but not both at the same time. The modsaf program can run as either a SAFstation only, a SAFsim only, or a combined SAFstation/SAFsim. The logger program can run as a logger only.

To summarize, any ModSAF computer can operate as one of the following:

1. Logger - use the logger program to record or play back an exercise.
2. SAFstation only - use when you want to heavily use the user interface to monitor the battlefield, perform terrain analysis, or issue many orders. Running the modsaf program with the flags **-gui -nosim** enables the SAFstation operation (-gui) and disables the SAFsim operation (-nosim).
3. SAFsim only - use when you want to get the maximum number of vehicles simulated. Running the modsaf program with the flags **-nogui -simulate** disables the SAFstation operation (-nogui) and enables the SAFsim operation (-simulate).
4. Combined SAFstation/SAFsim - use when you want to simulate a small number of vehicles with moderate use of the graphical user interface. Heavy use of the user interface takes computational resources away from the simulation. This option allows you to run ModSAF with a

minimum of hardware resources. Running the modsaf program with the flags **-gui -simulate** enables this combined operation.

12.2 Network Configuration

The network configuration determines how the individual ModSAF computers interact. Network configuration is accomplished by two flags: **-exercise** and **-database**. (There are other issues and flags concerning network configuration, such as protocol type and network interface, but it is assumed that they are all similarly set up and can be ignored.)

- The **-exercise** flag takes a number from 1 to 254 to set the simulation exercise IDentifier (ID). Only those computers set up to use the same exercise ID number can "see" and interact with each other's entities. Each computer on the same simulation network uses simulation (DIS) packets to build a shared database that describes the state of the physical battlefield.

  If two computers are on different exercise IDs, their simulated objects cannot interact. This, standard DIS feature, allows different training exercises to occur simultaneously on the same physical network. The exercise ID partitions the exercise into logically distinct networks and each exercise ID defines a different battlefield.
- The **-database** flag takes a number from 1 to 254 to set the database ID. ModSAF uses another set of packets called the Persistent Object (PO) protocol to share command, control, and mission state information among ModSAF computers. These packets support the PO database that ModSAF uses to request and control the simulation of ModSAF entities. PO database IDs are used to create independent PO databases.

  Only those computers set up to use the same exercise ID and database ID can share command and control information. Just having the same database ID is not sufficient. This feature prevents having the same command and control information for two different battles.

To implement the ModSAF equivalent of a traditional SIMNET SAF set up, start one computer as a SAFsim and another as a SAFstation. Be sure that both computers are on the same exercise ID and database ID. (No other computers should be on the same database ID.) When the SAFstation requests vehicles to be created, the SAFsim responds by simulating them. The SAFstation can then issue orders to those vehicles and monitor their physical and mission states.

To increase the number of ModSAF entities that the SAFstation can control, set up more SAFsim computers with the same exercise ID and database ID. When the SAFstation requests vehicles to be simulated, the SAFsims will arbitrate among themselves (based on current loading) to determine

which SAFsim will do the simulation. (Note, however, ModSAF does create all vehicles in the same platoon on the same SAFsim.)

Putting multiple SAFstations on the same PO database lets the SAFstations view each other's overlays and control each other's vehicles. This approach allows two operators to work together to more flexibly control the ModSAF forces. For example, if the forces controlled by one operator are under attack while the other operator's forces are not, the free operator can more closely control some of the other operator's forces, thus creating more realistic behavior.

To summarize, SAFsims can work together to provide a simulation server that responds to commands from users at SAFstations. For exercises requiring large numbers of entities, you would allocate more computers to run as SAFsims, thereby increasing your simulation resources. One user at one SAFstation can control a hierarchy of SAFsims to simulate large units with many entities. For exercises that require low levels of user control of SAF entities or human operator interaction with manned simulators via radio, more computers can be allocated as SAFstations. Multiple SAFstations can control entities simulated on one or many SAFsims.

Placing a Logger on the same PO database results in information about the unit hierarchies and the states of the vehicle and unit missions on that PO database. This lets the Logger create scenario files from a logger file. With these scenario files, ModSAF can restart the vehicles from SAFsims on that PO database at any point on the tape. If you are interested only in the physical state of the battlefield, you can turn off PO packet logging and record only the simulation (DIS) traffic.

13 ModSAF Logger

The logger program lets you record or play back a SIMNET or DIS exercise. You can decide which packet types to record or play back (SIMNET Simulation, Data Collection, Persistent Object, DIS Simulation, Radio, and Radio Signal). Therefore, you can choose to omit data during recording that was part of the original packet stream by limiting which protocols are played back (not everything in the file must be played).

The logger program has a graphical user interface (gui). Operations like play, record, stop, and pause are provided as graphic buttons, which you "push" using a mouse. The program can run on a workstation that has access to the network, or it can run on any machine with an IP connection.

The logger program is capable of several "special effects" during playback. The program can play back a recorded exercise using any exercise ID. It can play both faster- and slower-than-real-time, altering velocities to eliminate hopping. Freeze-frame and reverse playback are also provided.

To run the logger, first go to the directory that the logger object code resides in. Typically, this could be named "usr/common/src/logger". The logger object code is named "logger_<platform>" (logger_sgi, logger_sun4, or logger_mips). The logger user interface needs the X resource data found in the file 'common/src/logger/Logger'. If you are want to run the logger program after just logging in, issue the command **xrdb Logger** from the logger directory before running the program. If you forget to do this, the logger gui will come up, but it will not be completely or correctly drawn.

There are a few things to consider when running the logger and the ModSAF SAFstation:

1. When playing back an exercise from the logger that includes PO packets, there must be NO ModSAF SAFsims running anywhere on the network on that exercise.
2. When looking at a ModSAF SAFstation, any overlay received remotely from the network will default to NOT being shown. You must use the Overlay editor to cause remote overlays to be displayed.
3. System error messages are generally printed to the console from which the logger program was started. Some errors also generate a pop-up window on the user interface display.

Directions for performing typical logger operations and for using features such as the auto shut off switch are provided in the following sections. Directions for more sophisticated logger operations (such as using the Studio Button for editing operations) are documented in the file named loggeruser.texinfo located in the logger directory.

13.1 Playing a Logger File

1. Start the Program - Start the logger program by typing (without quotes) either
   - 'logger_<platform>' to display on the local display device, or
   - 'logger_<platform> -display <workstation>:0' to display on another workstation.
2. Display the User Interface - When the rectangular outline indicating the opening of a new window appears, click the mouse to display the logger's gui.
3. Enter the Filename - Click the **Open Log** button at the bottom of the gui. When the rectangular outline indicating the opening of a new window appears, click in it to view the Open Log selection display. Click on a file name in the displayed list to identify the file to be played back, then click the OK button. The Open Log display window will close and the selected name will appear in the File box of the user interface. The name of the file is expected to be a Unix pathname. Note: All the controls will be unresponsive until the file name is entered. If the entered file is found, many of the controls will become sensitive, including the Play buttons at the top of the screen. An insensitive Play buttons indicates that the file was not found. To edit the file name use the Backspace key to erase, type a new name, then press the Return key.
4. Set the Exercise - When the file name has been entered correctly, you must choose an exercise for playback. A default exercise is shown. If this default is not acceptable, click in the box marked Exercise, use the Backspace key to erase, type a different exercise number, and press the Return key. You can change the exercise during playback using the same procedure.
5. Choose the Protocols - The protocols stored in the file may be fine for playback. However, if you need to eliminate any protocol during playback, you can do so by clicking the box next to the protocol you wish to eliminate. A "green" box indicates that the protocol will be included in playback. The protocols are:
   - Simulation: The simulation protocol encompasses the bulk of the interactions that usually need to be logged for a SIMNET exercise.
   - Persistent Object: The PO protocol is needed for restarting an exercise from a logger file.
   - DIS: The DIS Simulation protocol encompasses the bulk of the interactions that usually need to be logged for a DIS exercise.
   - Data Collection: If a SIMNET exercise is going to be analyzed, then the Data Collection protocol should be recorded.
   - Radio: Radio traffic packets.
   - Radio Signal: Radio signal packets.
6. Set the Playback Speed - The slider directly below the buttons at the top of the screen controls the speed of playback. The speed is displayed numerically to the left of the slider. Speeds greater than 1.0 result in faster than real time playback. Speeds less than 1.0 result in slower than real time playback.

7. Press the Play Button - The fourth button from the left at the top of the screen is the Play button. Press this button to start playback. The elapsed time in seconds is displayed at the bottom of the screen. A number of other operations can be performed once playback has started:
   - Stop - To stop the playback, press the Stop button (second from the left at the top of the screen). All the vehicles will instantly disappear from the network. To start playing again, press the Play button.
   - Pause - To pause during playback, press the Pause button (leftmost button at the top of the screen). All the vehicles will stop where they are and remain on the screen; even missiles will pause in flight. To continue, press the Pause button again.
   - Change Speed - To change the playback speed to a fixed speed that is faster or slower than real time, adjust the speed slider. The new speed takes effect when the mouse button is released.
   - Play Backwards - Press the Reverse Play button (third button from the left at the top of the screen) to cause time to go backwards. Vehicles will back up along their tracks. Note that effects such as Weapons Fire are not shown during backward play. Backwards play can be initiated at any time during forward play, or after playback has stopped. To stop backward play, press one of the following: Pause, Stop, Play, or Loop Play (discussed below).

13.2 Skipping to a Different Time

1. Stop Playback - Press the Stop button to ensure that the logger is not playing; seek operations cannot be performed unless the logger is stopped.
2. Set the Time - There are two options:
   - Adjust the Seek Slider - The seek slider is just below the speed slider. When the slider control is at its leftmost position, playback will start at the beginning of the file. When it is at its rightmost position, the end of the file has been reached. The exact time remaining is displayed at the bottom of the screen.
   - Type a New Date and Time - If a file date and time have been specified, the boxes to the left of the seek slider display the current simulated time. To go to a known simulated time:

     ```
     1) Click at the end of the date or time box.
     2) Use the backspace key to erase the time shown.
     3) Type in the new time.
     4) Hit return to go to that time.
     ```

     If these boxes are empty, they will not accept a typed time. You must first set the File Time.

13.3 Playing a Section Repeatedly (Loop Play)

1. Enter a Filename - If the Loop Play controls are not sensitive, you must enter a file name to be played. See Section 13.1 [Playing a Logger File], page 114.
2. Set the Beginning of the Loop - The first slider in the Loop Play section is used to set the start of the loop. Set this slider the same way you set the Seek slider. See Section 13.2 [Skipping to a Different Time], page 115. Note: you are not allowed to move the beginning of the loop past the end of the loop.
3. Set the End of the Loop - The next slider in the Loop Play is used to set the end of the loop. Set this slider the same way you set the Seek slider. Note: you are not allowed to move the end of the loop before the beginning of the loop.
4. Press Loop Play - The Fifth button from the left at the top of the screen is the Loop Play button. Press this button to start loop play. The elapsed time in seconds is displayed at the bottom of the screen. When the end of the loop is reached, the logger will automatically jump back to the beginning of the loop and start playing again. All the operations available during normal play (Stop, Pause, Change Speed, etc.) can also be used during loop play.

13.4 Recording a Logger File

1. Start the Program - Start the logger program by typing either:
   - `logger_<platform>` to display on the local display device, or
   - `logger_<platform> -display <workstation>:0` to display on another workstation (with `<workstation>` being the name of the other workstation.)
2. Display the User Interface - When the rectangular outline indicating the opening of a new window appears, click the mouse to display the logger's graphical user interface.
3. Enter the Filename - Click on the **New Log** button at the bottom of the user interface. When the rectangular outline indicating the opening of a new window appears, click the left mouse button to display the New Log display. Click in the Selection box and type the name of the file to be recorded, then click the OK button. The New Log display window will close and the file name will appear in the File box of the user interface. The name of the file is expected to be a Unix pathname. Note: All the controls will be unresponsive until the file name is entered. If the entered file is found, many of the controls will become sensitive, including the Play buttons at the top of the screen. If the Play buttons do not become sensitive, it means the file was not found. You can edit the file name using the Backspace key, retyping, then hitting the Return key.
4. Set the Exercise - When the file name has been entered correctly, you should choose the exercise to be logged. If the default is not acceptable, click in the box marked Exercise, use

the Backspace key to delete the default, type a different exercise number, and hit the Return key.

5. Choose the Protocols - The default protocols may be fine for recording. However, if you need to select any extra protocols or filter out protocols, you can do so by clicking the box next to the protocol you wish to add or eliminate. A box which looks "green" indicates that the protocol will be included in the recording.
6. Set the File Time - Below and to the right of the Filename entry are two boxes, File Start Date and File Start Time. This time is useful during playback for seek and loop play operations. To set the File time and date, click in each box, type in the time (HHMM) or date (YYMMDD) of the exercise being simulated, and hit the Return key.
7. Press the Record Button - The rightmost button at the top of the screen is the Record button. Press this button to start recording. The elapsed time in seconds is displayed at the bottom of the screen. Note that recording does not start until the first packet is received. Two other operations can be performed once recording has started:
   - Stop - To stop the recording, press the Stop button (second from the left at the top of the screen). The file will automatically be closed and write protected.
   - Pause - To pause during recording, press the Pause button (leftmost button at the top of the screen). Changes on the battlefield will stop being logged. To continue recording, press the Pause button again.

13.5 Reading Statistics

The logger program updates the statistics regarding packet rate, vehicle count, file size, and elapsed time on the control screen so the user can monitor the logging.

1. Review the Statistics - The following statistics are available on the control screen:
   - Packet Rate (PPS) - The current packet rate in packets per second (PPS) is displayed in a graph near the bottom of the screen. During playback, this is the packet rate being generated by the player. During recording, this is the packet rate present on the network. Each line represents 100 PPS. Most simulators can handle packet rates of up to 1000 PPS.
   - Vehicles - The number of vehicles in the exercise is displayed in a graph near the bottom of the screen. During playback, this is the number of vehicles being generated by the player. During recording, this is the number of vehicles on the network. Each line represents 100 vehicles.
   - Tick Rate (Hz) - The current tick rate in Hertz (Hz) is displayed in a graph near the bottom of the screen. During playback, this is the mean tick rate over the previous second. During recording, a tick rate of zero is shown. Each line represents 1 Hz. A tick rate of 15 Hz is ideal, but a lower rate can occur occasionally.

- Data Size (bytes) - The current size of the file is displayed in a box near the bottom of the screen. During playback, this does not change. However, during recording, the size of the file is updated each second. Because of the compression method used, up to a minute can pass without any file growth if nothing on the battlefield is moving.
- Elapsed Time and Time Remaining (seconds) - The Elapsed Time in seconds is displayed during recording and playback. The Time Remaining in seconds is displayed only during playback. Note that these measurements may not be updated every second when the packet rate is very low. However, they will show true time when they are updated (for example, 5 seconds may pass without any change, then the elapsed time will be incremented by 5). During reverse playback, the elapsed time will decrease and the time remaining will increase.

13.6 Quitting Logger

1. Stop Playback or Recording - In order to guarantee that no data is lost, the Quit button is not sensitive during playback and recording. Press Stop to make the Quit button sensitive.
2. Press Quit - The Quit button is at the lower left corner of the screen. Pressing Quit will destroy that control screen. If more than one control screen has been created (using the Studio button), each screen must be Quit before the logger program exits.
3. View Ethernet Statistics - After the logger program exits, the console from which it was started displays net statistics for the run (including packets transmitted, packets received, and diagnostics). Also displayed are statistics indicating the minimum, average, and maximum number of packets which accumulated in the input ring (a measure of overall system performance).

13.7 Using Auto Shut Off

Auto Shut Off lets you start recording or playback, and then have the logger automatically stop at some time in the future.

1. Enable Auto Shut OFF - Click the box next to Auto Shut Off (near the bottom of the logger gui). The Auto Shut Off date and time indicators become sensitive.
2. Set the Date and Time - NOTE: The Auto Shut Off time is 'clock on the wall' time. The default shut off time is one hour in the future. To change the shut off time, click in the box marked "Time", use the Backspace key to delete the default value, type the time of shut off, and press the Return key. If you need to, change the box marked "Date" the same way. The current time displays next to the Auto Shut Off controls for reference. When enabled, Auto

Shut Off will automatically press the Stop button when the Auto Shut Off time is reached. A message will appear to let you know what happened, and Auto Shut Off will be disabled. Note: If a time earlier than the current time is entered while playback or recording is occurring, Auto Shut Off will happen as soon as you press the Return key.

3. If Necessary, Modify Auto Shut Off - Auto shut off can be modified by:
   - Disabling Auto Shut Off - If after enabling Auto Shut Off you wish to disable it, just click in the box next to Auto Shut Off. When disabled, this box does not look pushed in, and the Date and Time entries are not sensitive.
   - Changing the Auto Shut Off Time and Date - The Auto Shut Off time and date can be changed at any time prior to when shut off occurs. Edit each as described above.

13.8 Using Event Flagging Controls

Additions have been made to the Logger interface to handle flagging events. A new section, called "Event Flag Controls", appears in the logger gui above the "Loop Play Controls".

The figure below shows the layout and meaning of the buttons in this section.

```
 -----   -----   -----   ------------------------
| < | | > | | 0 | |(same as "Loop" button) |
 -----   -----   -----   ------------------------
Last     Next     Scan    Preview

* "Last" rewinds the logger to the previous time-ordered event
  flag in the log file.

* "Next" advances the logger to the next time-ordered event flag.

* "Scan" jumps to the next time-ordered event flag, plays for 21 seconds
  seconds, continues to the next event flag, and repeats these actions.

* "Preview" loops on the current event flag.
```

Directly underneath these buttons are a series of windows identifying the "Index", "Category" and "Memo" of the current event flag. The windows should appear similar to the following display:

```
        ---              ----------           ----------
Index | 0 |   Category | Bookmark |    Memo |          |
        ---              ----------           ----------
```

* "Index" is the number of the current event flag.

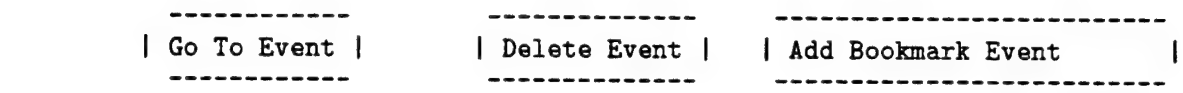
* "Category" identifies the category of the event.

  A "comment" event is generated in the voice logger when the operator presses the comment button on the microphone stand.

  A "bookmark" event is generated when the operator presses the "Add Bookmark Event" button (see below).

* "Memo" provides a space for the operator to add a textual comment to the event.

Underneath the editable windows is the following series of buttons:



* "Add Bookmark Event" will flag a "bookmark" category event at the current log time.

* "Delete Event" deletes the current event flag.

* "Event List" pops up the list of events, displaying the Time, Index, Category and Memo fields. You can select any event from the list in the same manner as selecting a file, and jump straight to that point in the log file.

13.9 Running Logger and ModSAF on One Computer

To run ModSAF and the logger on one machine requires the use of the program named pkttee. The source code for this program is located in the libpktvalve library and the program is described in the Overview of the libpktvalve.texinfo documentation. If this program needs to be compiled go to common/libsrc/libpktvalve and do: gmake pkttee.

You now run pkttee, logger, and modsaf (as three separate processes, in three separate windows) in the following order:

1. In common/libsrc/libpktvalve do:

```
pkttee 2100 3000 3001 3002
```

2. In common/src/logger do:

```
logger_<platform> -udp -noassoc -synch -tee 2100
```

When the logger GUI appears, click "New Log" and supply a filename for your logger file.

3. In common/src/ModSAF do:

```
modsaf_<platform> -udp -noassoc -tee 2100
```

When the ModSAF GUI appears, create and task the units. Go back to the logger GUI and click the record button.

Note: You can give the logger and modsaf programs unique simulation and PO database IDs if you don't want to use the defaults (simulation exercise 1 and PO database 1). Just be sure they are the same for both programs. The default terrain for both the logger and modsaf programs should be knox-0311. To use different terrain you would need to supply the -terrain <terrainname> option for both programs.

14 Dynamic Virtual Worlds Enhancements

14.1 Overview

The chapter, which serves as a *Dynamic Virtual Worlds (DVW) User Guide*, documents the environmental extensions to ModSAF made under the Dynamic Virtual Worlds in DIS project, contract number DACA76-94-C-0017. This work was directed by the U.S. Army Corps of Engineers, Topographic Engineering Center. It is part of the Advanced Research Projects Agency (ARPA) / Defense Modeling and Simulation Office (DMSO) Synthetic Environments program.

The DVW environmental extensions consist of a generic environmental architecture, additions to the baseline ModSAF system to provide environmental effects simulation, and modifications to the baseline ModSAF system to make use of these additions. These extensions add support for simulating environmental phenomena such as smoke plumes and time of day to increase realism in the ModSAF simulated environment.

To support the effects of environmental simulation, many ModSAF systems were modified or extended. For example, the PVD was extended to dynamically display smoke. The intervisibility (terrain) tool was modified to incorporate environmental effects on visibility. The Artillery editor was extended to include smoke munitions. A capability to launch self-defense smoke was added. Descriptions of how to use these extensions may be found in the capability tests covering each of these additions.

Capability tests are located in the *Acceptance Test Procedures for ModSAF*, Volume 3.

14.1.1 Dynamic Virtual Worlds (DVW)

The first build of the DVW program extends the simulated battlefield to include environmental phenomena such as solar and lunar illumination and obscurance from smoke, boundary-level aerosols, and rain. The first build also provides ModSAF units with some behavioral support for environmental effects, such as the ability to deploy tactical smoke and to detect and act upon signal smoke and flares.

14.1.2 DVW Environmental Extensions

The most fundamental environmental extension to ModSAF is the modeling of weather conditions, which includes the modeling of illumination. Other environmental extensions to ModSAF work within the framework of the current weather conditions and resulting output parameters (such as dew point and IR range).

The current environmental models are based on horizontally uniform weather conditions. Spatially varying weather is planned for future releases.

The ModSAF environmental architecture defaults to a constant model which simulates an exercise running on a clear sunny day. In the constant model, environmental parameters (such as temperature, solar/lunar illumination, and wind direction) cannot vary during the exercise. When ModSAF is invoked in this way, the list of environmental models printed in the startup shell are all held constant.

You must run ModSAF with the '`-allow_env`' option to allow ModSAF's environmental architecture to use varying models. See Section Environmental Features in ModSAF to configure selected dynamic models.

When varying evironmental models are enabled, settable environmental parameters (depending upon the models enabled) may be changed at any point in the exercise. See the section on Using the Environment Editor to effect these changes.

Also, the use of varying environmental models is required to provide support for environmental "effects". Environmental effects are models of localized phenomena such as smoke clouds and signal flares. These models work within the framework of the ambient weather conditions.

14.1.3 DVW Environment Features

The DVW environment features are the environmental models and evironmental effects added to the baseline ModSAF system. This *DVW User Guide* contains descriptions of the following environment features:

- Smoke plumes based on the Army Research Laboratory Battlefield Environment Directorate's Combined Obscuration Model for Battlefield-Induced Contaminants (COMBIC)
- Uniform Atmospheric Transmission based on the U.S. Air Force Geophysics Lab's LOWTRAN model.

- Ephemeris and natural illumination models
- Signal flares and signal smoke

See the section on Environmental Features in ModSAF for a full description of each of these features.

14.2 Using the Environment Editor

14.2.1 Parameters in the Environment Editor

When ModSAF is invoked with the constant model, the environment editor may be used to view the constant values used for environmental parameters. When ModSAF is invoked with varying environmental models, the Environment editor may be used to both view and set environmental parameters.

The ModSAF environment editor displays and updates parameters which are registered by the environmental models configured in the environmental reader files. See section Selecting Environmental Models for configuring models within reader files.

The Environment editor will display any model parameter when a "get" handler is registered by a configured environmental model. Whenever a "get" handler is registered by a model, it means that the model can provide a value for that parameter if it is queried.

The value of that parameter can be changed in the editor whenever a "set" handler is registered by a model. Whenever a "set" handler is registered by a model, it means the model can set the value of that parameter internally.

Parameters which have only "get" handlers registered will be insensitive to keyboard and mouse input and their values will generally be "greyed out". Parameters which have "set" handlers registered will be sensitive to keyboard and mouse input and will display their values in the normal foreground color.

A current limitation of the Environment editor is that the editor allows the user to change the value of any parameter which has a "set" handler registered. However, not all parameters which have "set" handler may actually be affected by user input due to interaction between configured

models. This occurs when more that one model runs simultaneously. A low-fidelity background model may allow a parameter to be set internally, but may be overridden by a higher-fidelity model which provides the parameter as output.

To understand which models may be set in the current invocation of ModSAF, one must look at the list of environmental parameters in the startup shell. Only those environmental parameters with a trailing "!" or no trailing punctuation can be modified. The non-modifiable parameters correspond to the models that are displayed with a trailing "?" at ModSAF startup time. The "!" and "?" do not display in the editor. Refer to section Defined Environmental Parameters and Models for more information.

In general, the actual output value of any parameter will be displayed in the Environment editor after the user selects the "Apply" button. If there is some question as to whether the value entered by a user is being overridden, examine the value of that parameter after using "Apply". If the value changes, it is being overridden internally by a model.

14.2.2 Sample Environment Editor Session

The following section describes a sample session using the Environment editor.

To use the Environment editor:

1. Run ModSAF with the '`-allow_env`' argument.
2. Click on the **Environment editor** button (the red button labeled with a thermometer on the ModSAF screen). The Environment editor displays the environmental parameters in the editor area of the screen. The Environment editor is larger than most editors and does not fit in the default space provided for editors. You may use the vertical scroll bar to examine clipped areas of the editor or you may use the window pane control button (located above the editor window, towards the left-hand side of the screen) to grow the size of the editor area temporarily.
3. Set the time using up/down arrows near clock.
4. Click APPLY. Note that the illumination, sun/moon AZ/El, and phase changes.
5. Change the days of the month; the moon phase should reflect the change.
6. Select **Fog (Adv)** extinction type and **.2 km** visibility.
7. Click APPLY. Scroll the editor, if necessary, to see the changes to the fields at the bottom. The extinction coefficients should go up dramatically from the default.

14.2.3 Setting Atmospheric Conditions

ModSAF supports data table-driven extinction coefficients. You can use data obtained from LOWTRN and AMSAA by setting the:

- Extinction type (i.e. rural, temperate, desert, maritime)
- Meteorological range
- Precipitation type (only rain is currently supported)
- Precipitation rate in mm/hr

Note that not all the extinction types displayed in the menu are currently supported. Reader files containing LOWTRN output have not yet been provided for unsupported extinction types. The following extinction types are currently unsupported. When they are selected in the Environment editor, the Rural extinction type is used internally:

- None
- Maritime
- Urban
- Desert

The following extinction types are currently supported:

- Rural
- Fog (Adv) [advective fog]
- Fog (Rad) [radiative fog]
- DsrtSum [desert summer]
- DsrtWin [desert winter]
- TempSumD [temperate summer day]
- TempSumN [temperate summer night]
- TempWin [temperate winter]

Another restriction is that not all meteorological ranges are supported for all extinction types. If an unsupported meteorological range for the extinction type is selected, the nearest supported

range is used. Unfortunately, the user interface does not indicate when this occurs, so please refer to the following list of valid combinations of extinction types and meteorological ranges.

The following are the supported combinations of extinction type and meteorological range:

- Rural [5.0km]
- Fog (Adv) [0.2km]
- Fog (Rad) [0.5km]
- DsrtSum [3.0km, 7.0km, 16.0km]
- DsrtWin [3.0km, 7.0km, 16.0km]
- TempSumD [3.0km, 7.0km, 16.0km]
- TempSumN [3.0km, 7.0km, 16.0km]
- TempWin [3.0km, 7.0km, 16.0km]

You can make additional changes by selecting a precipitation type of rain and various rain rates. These changes do not always take place, however, as it depends on whether a given extinction type has rain data defined. Currently, only the Rural and Fog extinctions support rain data.

14.3 Environmental Features in ModSAF

This chapter contains descriptions of environmental features added to ModSAF.

14.3.1 Battlefield Smoke

One of the environmental features added to ModSAF is the modeling of smoke clouds and the resulting obscurance effects. The incorporation of smoke clouds includes the addition of both the modeling of the smoke clouds and the addition of unit behaviors which allow the deployment of smoke. Smoke clouds will be created on the battlefield whenever units launch smoke as part of a task, the user initiates the deployment of a smoke munition from the Artillery Editor, or a tank is destroyed on the battlefield (resulting in a diesel fuel/oil/rubber smoke cloud).

14.3.1.1 Behavior Extensions to Support Smoke

Withdrawal under cover of self-defense smoke was added to support the deployment of tactical smoke on the battlefield. Self-defense (or self-protection) smoke is triggered automatically or if on phase line, semiautomatically. The Withdraw task, a unit-level task, groups enemy into clusters and assigns clusters to individual vehicles. The resulting line of site to the enemy is used in the launching of screening smoke grenades and optionally in determining the direction of the withdraw.

Withdraw Employing Smoke

The existing withdraw behavior was extended to include the use of screening smoke to cover the withdrawal. In addition, the Withdraw task supports:

- Employing suppressive fire through smoke (ie. fire at recently seen targets concealed in smoke or trees; extrapolate target's position for a short interval).
- Backuping up until line-of-sight to enemy is lost.
- Configuring route of withdrawal: along original route, specified route, or directly away from enemy.
- Occupying covered or concealed positions.

Sharing Turret Control

Two tasks attempt to control turret:

- Tracking main gun target
- Launching smoke toward center of threat cluster

When smoke is to be launched, the smoke launching preempts control of the turret.

14.3.1.2 Artillery Editor Smoke

In addition to smoke deployed by units during Withdraw tasks, the user may initiate the creation of smoke effects from the Artillery editor. The artillery editor is used in the normal manner. The list of munitions is simply increased to provide a selection of smoke munitions. (Refer to *USER'S GUIDE for ModSAF* for more information on the Artillery editor.)

The smoke munitions supported in the Artillery editor are:

```
M110E2 WP (White Phosphorus)
M328A1 WP
M825 WP
L8A1 RP (Red Phosphorus)
HC CAN smoke (105mm HC M2 cannister) (Hexachloroethane)
M18 HC Smoke, Red (hand-launched signal smoke grenade)
M18 HC Smoke, Green
M18 HC Smoke, Yellow
M18 HC Smoke, Violet
M84A1 HC Smoke (105mm HC M84A1 projectile)
M3A3 FO Smoke (Generator, ABC M3A3)
VEESS DF Smoke (Generator, VEESS)
M4A2 HC Smoke (smoke pot)
```

14.3.2 Destroyed Vehicle Smoke

Diesel fuel/oil/rubber smoke is generated when a tank is destroyed on the battlefield. The tank may be destroyed by fire from an enemy unit or the user can destroy the tank by using explosive munitions (e.g, bombs) in the Artillery editor.

However, smoke from burning vehicles can be computationally expensive, especially during and after large battles. Thus, under some circumstances, the user may want to run ModSAF with tactical smoke enabled, but without modeling smoke due to burning vehicles for performance reasons.

The user can configure the ModSAF to model tactical smoke without modeling smoke clouds due to destroyed tanks. This is done by commenting out the "munition" used to generate the diesel fuel/oil/rubber smoke cloud in a reader file.

To configure ModSAF to run without burning vehicle smoke, edit the file '**sms_mapping.rdr**' in the '**data**' directory

Note: the actual source for the '**sms_mapping.rdr**' file is in '**libsrc/libsmokesim**']. Find the line:

```
([objectDomainVehicle|vehicleEnvironmentGround]
                        environmental_Smoke_DFR_Medium)
```

And comment out that line by adding semi-colons to the beginning of the line:

```
;; ([objectDomainVehicle|vehicleEnvironmentGround]
                          environmental_Smoke_DFR_Medium)
```

14.3.2.1 COMBIC Model

The modeling of the obscurance effects of smoke clouds is based on the Combined Obscuration Model for Battlefield-Induced Contaminants (COMBIC) model.

The COMBIC model consists of:

- Smoke sources description–supports line and area intervisibility effects between observer and target
- Diffusion model–expansion of cloud
- Buoyant rise model–rise of warm clouds
- Boundary layer model–wind, temp, density vs. height

COMBIC Phase 1 models the time evolution of smoke and dust clouds produced by battlefield sources. COMBIC phase 1 smoke history files are precomputed and predistributed for the conditions of interest.

COMBIC Phase 2 calculates transmission through these clouds in one of seven wavebands. COMBIC Phase 2 has been machine translated to C and interfaced to the real-time state of clouds on the virtual battlefield. The transmission effects of COMBIC plumes are incorporated in the ModSAF target acquisition model.

For more information on the use of COMBIC smoke in ModSAF, refer to "Environmental Extensions to ModSAF" by Richard L. Schaffer. (This paper was presented at the Fourth Conference on Computer Generated Forces and Behavioral Representation, May, 1994.)

14.3.3 COMBIC Environmental Output Values

Precomputed COMBIC smoke is available for the following conditions:

```
                    METEOROLOGICAL CONDITIONS

  REFERENCE HEIGHT    10.00  METERS    WIND SPEED 1.00 METERS/SEC
      (changes for the
      different wind speeds)

  SURFACE ROUGHNESS 0.10000  METERS    WIND DIRECTION     270.0  DEG WRT
NORTH


  INVERSION HEIGHT     225.  METERS    TEMPERATURE        20.99  DEG
CELSIUS

  PRESSURE            1013.  MB        RELATIVE HUMIDITY   50.0  %

  PASQUILL CATEGORY      4

                    BOUNDARY LAYER PARAMETERS

  FRICTION VELOCITY    0.087 M/SEC     PASQUILL CLASS            3.60

  KAZANSKI-MONIN      0.0000           OMEGA                    0.837

  COLD REGION FLAG       0             SBAR MODEL FLAG             0

  AIR DENSITY         1194.5 G/M**3    1/MONIN-OBUKHOV LENGTH  0.00000
M**-1

  SENSIBLE HEAT FLUX      0.0 WATT/M**2 SURFACE BUOYANCY FLUX   0.0000
M**2/S**3

  MEAN STATIC SBAR (10-50M)  0.000000  SEC**-2

                          SURFACE CONDITIONS

  SNOW COVER FLAG    0    SILT CONTENT 50.0 %    SOD DEPTH  0.000 METERS
```

Supported Wind Speeds

Each combic munition was precomputed for three wind speeds: 1 mps, 5 mps and 13 mps (meters per second).

Each munition was precomputed as a single round.

General Input

General input includes:

- Date and time
- Location
- Surface characteristics such as roughness, silt percentage, sod depth, and snow cover (binary).

14.3.4 Uniform Atmospheric Transmission

Uniform atmospheric transmissions includes visibility effects of boundary-level aerosols and rain rate. (Data is precomputed using LOWTRN which calculates the transmittance and radiance within a horizontally uniform atmospheric region.)

LOWTRN, part of ARL's Electro-Optical Systems Atmospheric Effects Library, calculates transmittance and radiance within a horizontally uniform atmosphere model.

Tables of volume extinction coefficients for horizontal propagation are precalculated and predistributed for the conditions of interest. The transmission effects are incorporated in the ModSAF target acquisition model.

See the section on Setting Atmospheric Conditions for using the LOWTRN model to set atmospheric conditions in ModSAF.

14.3.5 Ephemeris / Illumination Model

The ephemeris model is used to simulate the illumination level of the battlefield due to the position of the sun and moon.

Solar and lunar positions are calculated based on location and time. The ephemeris inputs are the geographic location of the the terrain database and the current time of day. Outputs of the model are: lunar azimuth/elevation and solar azimuth/elevation.

Illumination is calculated from a table-lookup based on solar / lunar elevation angle. The illumination level selects the appropriate minimum resolvable contrast table within the target acquisition model.

See the section on Setting Atmospheric Conditions for using the ephemeris model to set illumination in ModSAF.

14.3.6 Signal Flares and Signal Smoke

Another environmental feature added to ModSAF is the modeling of signal smoke clouds and flares. The incorporation of signals includes the addition of new behavior to support the use of signals, the modeling of the signal effects, and the model used for unit detection of the signals (at both the individual vehicle and unit levels).

14.3.7 Using Signals

A new enabling task was added to ModSAF to provide behavioral support for using signal smoke and signal flares. The enabling task allows the user to select any supported signal as the trigger for a transition from one phase in the execution matrix to the next.

Note: In order to use signal detection behavior, you must configure ModSAF reader files to include signal detection. Supporting signal detection does decrease ModSAF performance even if no signals are used, so by default ModSAF is configured with signal detection turned off.

Two reader files must be edited in order to turn signal detection on. Both reader files are located in the '`src/entities`' directory. First edit '`standard_params.rdr`'. Look for two lines of the form:

```
;;(SM_SignalDetect (range 4000.0) (period 2000)) ; km, msec
```

And remove the comment characters from the beginning of the line:

```
(SM_SignalDetect (range 4000.0) (period 2000)) ; km, msec
```

This enables the physical model in each individual vehicle which simulates the vehicle's ability to sense [both visually and aurally] any existing signals.

The other file to modify is '`macros.rdr`'. Look for the section:

```
;; Signal detection related macros:
SIGNAL_DETECTION_ON_OR_OFF {
        (background off)
}
```

Change the off to on:

```
;; Signal detection related macros:
SIGNAL_DETECTION_ON_OR_OFF {
        (background on)
}
```

This change enables both vehicle-level and unit-level signal detection tasks. These tasks are used to remember and coordinate knowledge of signals across a unit.

After configuring the ModSAF reader files, invoke ModSAF with the '`-allow_env`' switch.

The following is a sample session showing how a signal may be used to transition between phases in the execution matrix.

- Create a M1 platoon.
- Task the platoon with a Halt followed by a Move, with a green flare as the Signal for phase linkage. Remain in the Unit editor.
- From the Artillery editor, detonate a red flare within visual range of the unit. Observe that the platoon remains halted.
- From the Artillery editor, detonate a green flare within visual range of the unit. Observe that the platoon executes its Move, with planning graphics.

A restriction in the Signal enabling task is that flares and signal smokes are not supported in all the colors available in the menu. Signal smoke is only available in red, green, yellow, or violet. Signal flares are only supported in red, white and green. This is intended to reflect the actual availability of signal colors in the field.

However, a user could configure a phase to transition upon detection of an illegal combination, e.g, a violet flare. If the user were to do this, the transition could not be triggered because it is not possible to launch a violet flare (see section Launching Signals).

Lastly, note that there is no distinction between cluster flares and parachute flares in the Signal enabling task. This is due to the fact that no tactical distinction is made between these two types of flares in the field.

14.3.7.1 Launching Signals

To launch a signal:

- Enter the Artillery editor (Refer to *USER'S GUIDE for ModSAF* for more information on the Artillery editor.)
- Select the option from the displayed menu (M18 smoke: red, green, yellow, or violet; parachute or cluster flares: red, white, or green).
- Select a location on the map. By default, the editor detonates the munition immediately.

ModSAF creates a signal entity, displaying it on the PVD and issuing PDUs by which other entities may detect it.

14.3.7.2 Simulating Smoke and Flare Entities

To simulate smoke and flare entities, run ModSAF using the '`-allow_env`' option. Smoke and flare entities can transmit special case environmental packets on the network. Smoke entities resulting from launched smoke grenades degrade visibility.

14.3.7.3 Tabulated Values of Flare Characteristics

Upon receipt of a Detonation PDU for a signal munition, ModSAF looks up configuration data for the signal and begins simulation of the signal entity. For signal flares, this data is stored in '`data/fls_flares.rdr`', and includes burn time and rate-of-fall. ModSAF calculates the movement of the flare (descent and travel with wind) and issues environmental entity PDUs for it as required. Once the burn time has expired, the flare is marked "inactive," denoted on the PVD as a change in icon color from white to black. The entity is terminated eight seconds later.

14.4 Selecting Environmental Models

Environmental data is dispatched to models that have registered handlers for individual parameter types.

You can select the environmental models that will be run by changing the '**environment.rdr**' file. There are three general types of models. Local models can only answer queries for a limited region of space. Ambient models can answer queries anywhere. Resolver models combine the results of other models.

To display a list of resolver (R), ambient (A), and local (L) models:

- Run ModSAF
- Type **print environment** at parser

To select the models to be run:

- Edit '**data/environment.rdr**'
- Change a model from ON to OFF. (This change should be in effect when you rerun ModSAF.)

The following shows how to configure '**environment.rdr**' from the default illumination model (which uses ephemeris), to using the constant model for the moon phase, but using ephemeris for other aspects of illumination.

Change the section of code which configures the illumination model from the default (using ephemeris):

```
(simple-ephemeris       ANY                 on)
(constant               SUN_POSITION        off)
(constant               MOON_POSITION       off)
(constant               MOON_PHASE          off)
(constant               ILLUMINATION        off)
```

To one which turns off the ephemeris moon phase model and turns on the constant moon phase model:

```
(simple-ephemeris       MOON_PHASE          off)
(simple-ephemeris       ANY                 on)
(constant               SUN_POSITION        off)
(constant               MOON_POSITION       off)
(constant               MOON_PHASE          on)
(constant               ILLUMINATION        off)
```

Note: When ModSAF is run, models that are registered but currently disabled are flagged with an asterisk (*) in the display. Changing the reader file should alter the status display.

14.4.1 Defined Environmental Parameters and Models

The following table lists the parameters and models in the fully configured version of ModSAF. The left-hand column of the table lists the environmental parameter. The right-hand column lists the executing model or models that support that parameter.

If an "!" or no punctuation displays after a model name, it should be possible to modify the indicated parameter. If a "?" is the only punctuation after the model name, the indicated parameter is displayed only and cannot be modified.

```
INTERNAL_STATS          R: statistics?   C: net-weather constant?
TEMPERATURE             A: net-weather
DEWPOINT                A: net-weather
RELATIVE_HUMIDITY       A: net-weather
BAROMETRIC_PRESSURE     A: net-weather
WIND_VELOCITY           A: net-weather
PRECIPITATION_TYPE      A: net-weather
PRECIPITATION_RATE      A: net-weather
EXTINCTION_TYPE         A: net-weather
EXTINCTION_AMOUNT       A: net-weather
EXTINCTION_COEFF        A: uniform-atmosphere?
RAY_VISIBILITY          R: multiply? A: constant L: combic?
VISUAL_RANGE            A: simple-range?
ILLUMINATION            R: add? A: simple-ephemeris?
SKY_OVER_GROUND         R: priority? A: simple-sog?
CLOUD_COVER             A: net-weather
CLOUD_CEILING           A: net-weather
SIM_TIME                R: priority? A: net-weather
SUN_POSITION            R: priority? A: simple-ephemeris?
MOON_POSITION           R: priority? A: simple-ephemeris?
MOON_PHASE              R: priority? A: simple-ephemeris?
CONTRAST                A: constant
BATCH                   C: net-weather!
```

```
FLUSH                          C: net-weather!

Requestable environmental effects:

SMOKE_EFFECT                   combic
FLARE_EFFECT                   flare
```

Appendix A Menu Component Operations

The pulldown menus, editor displays, and pop-up windows that appear on the screen often contain various menu components for data entry and parameter editing. Directions for working with these menu components are provided in the following sections.

A.1 Insert a Value

1. Click the outline box on the display area that requires a value. A blinking insert cursor (small black bar) appears.
2. Enter a value.

A.2 Alter Text

1. Click the space after the character you want to change. A blinking insert cursor appears. Press BACKSPACE or the DELETE key repeatedly to delete one character at a time in a right-to-left direction. Enter new text. (You must press RET for text appearing in inverse video.
2. The current editor Help line may instruct you to press SPACEBAR to delete text. **Note:** Erasing and entering new text may be easier than editing the existing text.

A.3 Select a Value from a List

To select a different value for a parameter:

1. Move the mouse pointer to the current value.
2. Press the left mouse button. A display of all elements in the list appears.
3. Click to select a different value from the list.

A.4 Select a Value from the Map

Some parameters, such as a location or distance parameter, are set by using the Map.

1. There are several ways to select a value from the Map:
   - Click a coordinate box to let the editor know you want to change a coordinate. The coordinate box is outlined in red to show its selection. Click a position on the Map. The coordinates are automatically displayed. (You can also change these coordinates using the keyboard.)
   - Click the display's Map input button. This button is labeled to indicate its function. For example, `Click Here for Map Input`. Click an object or location on the Map.
   - Type a new value, or click the Map and drag, to stretch a "ruler" to change a distance value.

A.5 Set a Dial

Some parameters, such as the vehicle scale or competence parameter, are set by an indicator (pointer) in a semi-circle dial.

1. There are two ways to adjust the dial setting:
   - Click the dial to position the indicator.
   - Hold/Left on the indicator. Move the mouse to set it. Release the left button when the indicator is at the correct setting.

A.6 Change an Angle Setting

Some parameters, such as the direction parameter, are set by adjusting an angular value. These parameters are indicated by an encircled arrow.

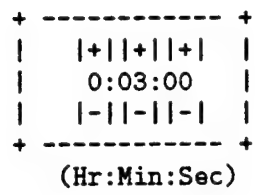
1. Adjust the type of measurement unit (such as degrees or mils), if necessary, by clicking a new "only-one-on" unit toggle (see the following section).
2. There are several ways to adjust the angular value:
   - Replace the text. Press the `SPACEBAR` to erase the current text. Enter a new value.
   - Hold/Left on the encircled arrow, and drag the mouse to set the indicator. As the indicator moves, the angular value changes to reflect the current setting. Release the left button when the indicator is at the correct setting.
   - Click the circle to position the arrow indicator, thereby indicating a new angle value.

A.7 Change a Toggle Setting

1. There are two types of toggle settings:
   - Off/On parameter toggles can be preceded by a toggle box (for example, the dashed setting for control measures or the display setting for a terrain feature). When you click the parameter, you change the setting. If the setting is **off**, it changes to **on**, and the box appears recessed. If the setting was **on**, it toggles to **off**, and the recessed toggle box either disappears from the display or appears highlighted.
   - Only-one-on toggles are diamond-shaped. Use these toggles to select a value from a group. When you click a toggle, if the setting is **off**, it changes to **on**. The settings of other diamond-shaped toggles in the group are set to **off**.

A.8 Adjust a Meter

The following figure shows a sample meter:



1. There are two ways to adjust the time shown in a meter:
   - Replace the time text. See Section A.2 [Alter Text], page 141.
   - Use the up-arrow or down-arrow that corresponds to each time element (hh:mm:ss). To increase a value, click the up-arrow until the value reaches the desired number. To decrease a value, click the down-arrow until it reaches the desired number.

A.9 Scroll Vertically

If the data is too long to fit completely in the display area, a vertical scroll bar appears to the right of the display area. The scroll bar contains a grey box indicator.

1. Hold/Left on the grey box indicator.

2. Move the mouse to set the indicator. As the indicator moves, the data scrolls vertically.
   Note: An arrow appears at each end of the vertical scroll bar. Click the arrow as an alternate way to scroll.

A.10 Scroll Horizontally

If the data is too wide to fit completely in the display area, a horizontal scroll bar appears beneath the display. A grey box indicator is in the scroll bar.

1. Hold/Left on the grey box indicator.
2. Move the mouse to set the indicator. As the indicator moves, the data scrolls horizontally.
   Note: An arrow appears at each end of the horizontal scroll bar. Click the arrow as an alternate way to scroll.

Appendix B Task Frames

There are several types of task frames:

- Ground vehicle and small unit frames
- Ground company frames
- Ground battalion frames
- Fixed-wing aircraft (FWA) frames
- Rotary-wing aircraft (RWA) frames

When you select a frame containing a task requiring input, ModSAF automatically displays that task's editor in the Editor Area. A help message (written in red) appears in the Current Editor Help line to prompt you for input. For example, a movement frame needs a route or destination point, so ModSAF asks you to supply one before you can complete the frame selection process.

Once you assign a frame to a unit, you can view or modify any editable tasks in the frame. Click the frame name in the execution matrix and select the **`Modify task...`** or **`Modify Temporarily`** option. Editing most task parameters is not required since the default settings are usually adequate.

A unit, while preparing to execute a frame or waiting for an On Order, executes a prep (preparatory) time task. The prep time task is dependent on the type of unit. Typically, ground units execute a Halt, RWA units execute a Hover, and FWA units execute a Hold. However, those frames that instruct a unit to occupy a position (Hasty Occupy Position and Attack by Fire) are an exception. The prep time task for those frames (Prep-Occupy-Position) tells the unit to move to its defensive location.

You can simulate a mixed-platoon composed of subordinate platoons; for example, a Dismounted Platoon/Infantry Fighting Vehicle (DI/IFV) unit. When you assign a frame at the mixed-platoon level; ModSAF spawns the necessary task frames on the subordinate platoons. When you assign a frame down at the subordinate platoon level rather than at the mixed-platoon level, ModSAF spawns the necessary unit level tasks to the assigned platoon only. For example, if you assign a Move frame to a platoon of M2s, ModSAF spawns a movement task on the M2 platoon. However, if you assign the Move frame to a dismounted DI/IFV platoon, ModSAF automatically assigns a movement task to each of the two subordinate platoons. The IFV platoon is assigned a unit `Travel` task and the DI platoon is assigned a unit `Follow` task. The follow offsets are set so that a DI follows in front of an IFV. This allows the DI and IFV to move in a coordinated pattern.

Note: An improved DI-hull model in ModSAF 1.5 introduces a fatigue model, and DI postures (standing, kneeling, prone). A DI's energy level (and resultant posture) decreases while the DI move.

B.1 Ground Unit Task Frames

You can assign ground unit task frames to a ground vehicle or to a small ground unit only.

A unit, while executing a frame, can monitor the battlefield for a reaction-triggering situation (such as ground enemy contact, air enemy contact, or indirect fire). For example, when a ground enemy is encountered, a unit can perform the reactions specified in the **Actions-on-Contact** task. The default Actions-on-Contact reactions are set at **Contact Drill** which tells the unit to set its fire permission to "Free" and continue its mission.

B.1.1 Move Frame

The **Move** frame instructs a ground unit to drive cross-country (unit stays in formation even when following a road route) to a specified location. You must specify a route (point, line or text) when you assign the frame.

The Move task frame has several editable tasks: the Travel, Actions-on-Contact, React-Air, and React-to-Indirect-Fire task. The Travel task handles movement. The other tasks handle reactions by monitoring the battlefield for ground enemy contact, air enemy contact, or indirect fire.

The following procedure creates a Move task frame:

1. Select **Move** from the list of available task frames. Since the Move frame's **Travel** task needs a destination point or route, the Travel task editor appears in the Editor Area.
2. Click in the Map to create a destination point or select an existing point or a route from the Map. If you prefer to create a new route. click the Line button, place the line, and click **Done** in the Line editor.
3. Edit the other Travel task parameters (such as Rate-of-March, Formation, Spacing, and Catch-Up Speed) if desired.

   Open spacing is 100 meters, closed spacing is 50 meters, and user-specified formation spacing is set to the value set in the user-specified spacing field.

   Rate-of-March is the desired speed. Catch-up speed is the speed limit for a vehicle that has fallen behind and needs to "catch up" to its unit. A catch-up speed set at zero means there is no speed limit (except the vehicle's maximum speed).
4. Click **Done** in the task editor when you are finished editing.

B.1.2 Road March Frame

The **Road March** frame instructs a ground unit to perform a road march (staying on the road when a road route is assigned) to a specified location. When you assign this frame, you must specify a route (point, line or text).

This task frame has several editable tasks: Travel, Actions-on-Contact, React-Air, and React-to-Indirect-Fire. While executing this task frame, the unit monitors the battlefield for enemy contact, indirect fire, or air attack.

The following procedure creates a Road March task frame:

1. Select **Road March**. The movement task needs a destination point or route, thereby the Travel task editor appears in the Editor Area.
2. There are several ways to supply a destination:
   - Click in the Map to create a destination point.
   - Select an existing point or route from the Map.
   - Create a new road route by clicking the Line button. Set the **Use Roads** toggle to on. Place vertices on road network segments. Click **Done** in the Line editor.
3. Edit the other task parameters if desired.
4. Click **Done** in the task editor when you are finished.

B.1.3 Follow a Vehicle Frame

The **Follow a Vehicle** frame instructs a ground unit to follow a ground ModSAF vehicle (lead vehicle) that you select from the Map. The unit's movement task is given a vehicle to follow (and offsets) and an optional route. If a route is given, the platoon follows that route but tries to keep station on the vehicle (the followers adjust their speed). If a route is not given, every 10 seconds the unit attempts to determine where the leader will be located within 60 seconds. It then generates a route based on that information.

If the leader does not travel more than five meters between two 10-second samples, the internal route does not change. If the leader does move more than the threshold five meters, new locations are selected.

When the network id of an incoming fire packet matches that of the lead vehicle, following vehicles are given the chance to fire as long as their fire permission is not set to "Hold". This

ability to perform cued fire gives following (cued) vehicles an opportunity to fire whenever the vehicle they are following or monitoring receives fire. Cue firing was designed for operation with both ModSAF vehicles and SIMNET simulators.

Cued firing occurs only if the lead vehicle has fired within a specified interval. In other words, if a following vehicle can't fire a shot within this interval, it bypasses its chance to perform cued firing. This interval is a parameter for the vehicle targeter task. If the lead vehicle is destroyed or deleted, the following vehicles will continue to shoot until the specified parametric time period has passed.

The task frame has several editable tasks: Travel, Actions-on-Contact, React-Air, and React-to-Indirect-Fire. The unit monitors the battlefield for a reaction-triggering situation (enemy contact, indirect fire or air attack).

The following are suggestions when using the Follow a Vehicle frame:

- When following a vehicle, if the leader stops and you want to adjust the subordinates' positions, assign an `Occupy Position`.
- If the leading vehicle suddenly turns sharply, the followers quickly exchange places to return to formation.
- The routes generated by the vehicles "guess" the leader's future location. If that guess includes a river, the followers may become confused. If a platoon is to follow a vehicle across a bridge, the leader vehicle may need to stop on the other side of the bridge to wait for the followers. Once the leader stops, the followers should know their exact destination.
- You must indicate to the following platoon that it should use the road route that its leader is using unless otherwise noted.

The following procedure creates a Follow a Vehicle task frame:

1. Create a single M1 vehicle, and behind it create a platoon of M1s.
2. Assign the platoon a `Follow a Vehicle` frame. The movement task needs a vehicle to follow, thereby the Travel task editor appears in the Editor Area.
3. To set a leader vehicle, click the single M1 vehicle in the Map.
4. To set the offsets, set the Follow Distance and Follow Angle parameters.

   Note: For the Follow Angle setting, the default arrow points downward (3200 mils or 180 degrees) indicating that the unit is to follow behind the leading vehicle. (If you change the arrow to point upward, the unit follows in front of the leader vehicle. Correspondingly, setting

the arrow to east sets the vehicle to follow to the right and setting the arrow to west sets the vehicle to follow to the left.) Supplying a route is optional.

5. Click **Done** in the task editor when you are finished editing.
6. Assign a Move frame to the M1 vehicle.
7. Issue the On Order for both the frames.

   Note: You should see the vehicles start to move. By default, the fire permission is set to "tight" on the platoon and the individual M1.

B.1.4 Follow a Simulator Frame

The **Follow a Simulator** frame tells the unit to follow a ground simulator that you select from the Map. To do this, ModSAF deletes the leader vehicle in the following unit, if it exists, so that the simulator can take its place in the formation. This deleted vehicle is the one with task org ID 0, for example, vehicle A11 in platoon A. Note: You will see a warning about this deletion on the Follow-Simulator task editor.

The simulator is functionally organized into the unit hierarchy and joins the unit formation as the platoon leader. Since the unit movement and formation software considers the simulator the unit leader, the remaining platoon vehicles maintain their formation while adjusting their speed and tracking their position and orientation (station keeping) off of the simulator.

Changes in simulator state can break the platoon-simulator connection. If the leading simulator dies or suffers a mobility failure, the platoon occupies a defensive position and waits for further orders. If the simulator is restored and it is close enough to the unit (the simulator falls within the "Rejoin Distance" limit), the platoon-simulator connection can be restored.

A change in platoon state (such as when the platoon is tasked to temporarily separate from the simulator) can also break the platoon-simulator connection. When this happens, the Follow a Simulator frame can only be resumed if the distance between the platoon and simulator falls within the "Rejoin Distance" limit. If the distance it too great, the platoon will occupy a position rather than follow the simulator.

When the following unit's fire permission is "Tight", it is given the chance to fire when the simulator fires. The unit monitors the simulator and gets an opportunity to fire whenever its lead vehicle does. However, this cued firing must occur within a specified interval. In other words, if a cued vehicle is not able to fire a shot within this interval, it bypasses that chance to fire. This interval is a parameter for the vehicle targeter task. Note: If fire permission on the following unit is

set to "Hold", the cued vehicle can not shoot. If the simulator is destroyed or deleted, the following vehicle will continue to shoot until the specified parametric time period has passed.

The task frame has several editable tasks: Follow-Simulator, Actions-on-Contact, React-Air, and React-to-Indirect-Fire. The unit monitors the battlefield for a reaction-triggering situation (enemy contact, indirect fire or air attack).

When you are asked to select a simulator to follow, ModSAF automatically excludes known ModSAF vehicles. However, you can try out this operation by making use of two ModSAF "pocket" systems running on the same simulation exercise, but a different PO database. This lets you generate a fake remote "manned simulator".

The following procedure creates a Follow a Simulator task frame:

1. On machine A, bring up a ModSAF "pocket" system with PO database 2 and simulation exercise 4.
2. On machine B, bring up a ModSAF "pocket" system with PO database 3 and simulation exercise 4.
3. On machine A: create a single M1 vehicle. This M1 will serve as a "simulator".
4. On machine B create a platoon of M1s behind the single M1 vehicle.
5. Assign the platoon a **Follow a Simulator** frame. The platoon needs a simulator to cue its behavior from, thereby the Follow-Simulator task editor appears in the Editor Area.
6. To set a simulator, click the single M1 vehicle in the Map.
7. Click **Done** in the task editor when you are finished editing.
8. On machine A: assign a Move frame to the M1 vehicle.
9. Issue the On Order for both the frames.
   Note: You should see the vehicles start to move. By default, the fire permission is set to "tight" on the platoon and the individual M1.
10. Create a T72 platoon in a location visible to the M1 vehicle.
11. Use the ROE button to set the fire permission of the T72 platoon to "Hold".
    Note: Once the lead simulator fires, the following vehicles should be able to fire on the T72s.

B.1.5 Pursue Frame

The **Pursue** task frame tells a ground vehicle or unit to pursue a unit you select from the Map. The pursuing unit chases but does not overtake this selected unit. This frame continues until you issue a new order.

The task frame has several editable tasks: Travel, Actions-on-Contact, React-Air, and React-to-Indirect-Fire. While executing this task frame, a reaction to enemy contact, indirect fire or air attack can occur.

To view the Pursue frame:

1. Create an M1 platoon.
2. Task the M1 platoon to move along a route.
3. Create another M1 platoon.
4. Task the second platoon, using the execution matrix, by selecting the Pursue frame. The movement task needs a unit to pursue for the route input, thereby the Travel task editor appears.
5. Select either a vehicle in the first platoon to pursue or select **Show as Platoons** and click the first platoon icon in the Map. Notice that the second M1 platoon moves towards the first.

   The route updates occasionally to adjust to the movement of the first platoon. The pursuing unit pursues and follows the first platoon. It cannot end the frame nor overtake the first platoon.

B.1.6 Halt Frame

The **Halt** task frame tells ground vehicles to stop. It instructs vehicles on a road to drive to alternating sides (herringbone formation), and instructs vehicles that are not on a road to stop in formation. There are no required inputs for the Halt frame.

The Halt frame does not end. When you use a Halt frame in an execution matrix and use **Continue** to transition to the next phase, the frame for the next phase must have an **On Order**.

To execute a herringbone formation, a unit reorders its subordinates based on their position on the road. This ordering is accomplished by determining the number of peers behind each subordinate. The subordinate with the most peers is the first vehicle; the subordinate with the least is the last vehicle. Once this order is determined, the herringbone formation is accomplished by instructing the even-numbered subordinates to the left side of the road, and the odd-numbered subordinates to the right side. The "distance off the road" and the "stopping look ahead time" are parameters in the configuration files.

The Halt task frame has several editable tasks: the Actions-on-contact, React-Air, and React-to-Indirect-Fire task. While executing this task frame, the unit monitors the battlefield for a reaction-triggering situation (enemy contact, indirect fire or air attack).

To view the Halt frame:

1. Create an M1 platoon.
2. Assign the platoon a **Move** frame along a cross-country route by using the execution matrix.
3. Assign a Halt to the moving vehicles by using the "Replace Temporarily" option. The vehicles should stop.
4. Restart the halted vehicles via the "Resume" option.

B.1.7 Assemble Frame

The Assemble task frame instructs a moving ground vehicle or unit to form a coil formation and then stop moving. There are no required inputs for the Assemble frame.

The Assemble frame does not end. When you use an Assemble frame in an execution matrix and use **Continue** to transition to the next phase, the frame for the next phase requires an **On Order**.

This task frame has several editable tasks: the Actions-on-Contact, React-Air, and React-to-Indirect-Fire. While executing this task frame, the unit monitors the battlefield for a reaction-triggering situation (enemy contact, indirect fire or air attack).

To view the Assemble frame:

1. Create an M1 platoon.
2. Assign the platoon a **Move** frame along a cross-country route by using the execution matrix.
3. Assign an Assemble to the moving vehicles by using the "Replace Temporarily" option. The vehicles should get into coil formation and stop moving.
4. Restart the halted vehicles by using the "Resume" option.

B.1.8 Change Formation Frame

The Change Formation task frame instructs a ground unit to move into a specified formation. When assigning this frame, you must specify a destination. The vehicles move to their new position after a small time delay which is specified in the Change-Formation task parametric data.

This task frame has one editable task: Change-Formation. While executing this task frame, the unit does not react to enemy contact, indirect fire or air attack.

To view the Change Formation frame:

1. Select **New Scenario**.
2. Create an M1 platoon.
3. Assign the platoon a **Change Formation** frame using the execution matrix.
4. When the Change-Formation task editor appears, click in the Map to set a destination point. Change the formation and direction if you wish. Click **Done** in the task editor.
5. Issue the On Order. The platoon will move to the new destination and will assume the specified formation and direction.

B.1.9 Hasty Occupy Position Frame

Hasty Occupy Position instructs a ground unit to:

- occupy a battle position
- find a cover position that offers visibility to the engagement area
- set its sectors of fire between two target reference points.

When you assign this frame, you must specify a **battle position** and an **engagement area Target Reference Point (TRP)**. To specify a battle position, select a line or create one by using the Line button. To specify a TRP, select a point or create one by clicking in the Map.

Based on the battle position and the number of subordinates, ModSAF calculates both the number of vehicles per segment (the battle position consists of one or more line segments) and the battle areas (areas where each vehicle searches for cover positions). ModSAF assigns the unit subordinates positions from one end of the battle position to the other in an order that prevents vehicle crossover when the vehicles travel to their positions.

When the unit arrives at the battle area, ModSAF attempts to place the vehicles in covered (hull defilade) positions along the battle position line. ModSAF considers a vehicle's limits for angles of elevation and depression when selecting a good cover position; a vehicle is not placed at a location where underlying terrain prevents the gun from being physically pointed at the enemy. If that location is behind a tree line or building and no cover location is found, the vehicle moves

to a concealed (partially hidden) location behind the tree line or building. The vehicles also move to areas where they can maintain visibility to the engagement area TRP. Enemy vehicles detected within the sector of fire determined by the left and right TRPs are considered first priority targets.

By default the unit attempts to alternate firing positions. See Section C.5 [Occupy-Position Task], page 195.

Usually a ground unit halts while waiting for you to issue On Order authorization. This frame does not; rather, it moves the vehicles to battle positions while waiting for your On Order.

The task frame has several editable tasks: the Occupy-Position, Actions-on-Contact, React-Air, and React-to-Indirect-Fire. Once the unit arrives at the battle position, it monitors the battlefield for a reaction-triggering situation (enemy contact, indirect fire, or an air attack).

Use the following procedure to view a Hasty Battle Position:

1. Select **New Scenario**.
2. Create an M1 platoon.
3. Assign the platoon a **Hasty Occupy Position** frame using the execution matrix. Because this frame needs input, a task editor appears.
4. To create the battle position line:
    1. Click the Line button.
    2. Click the Map to position the battle position line vertices.
    3. Click **Done** in the Line editor.
5. To specify the expected enemy location:
    1. Click the Engagement Area "Click Here for Map Input" button.
    2. Click the Map. (Note: you can use previously created graphics as well as newly created ones.)
6. Specifying TRPs to delineate the unit sector of fire is optional. If you do not supply them, ModSAF generates them automatically. To create the left TRP:
    1. Click the left TRP "Click Here for Map Input" button.
    2. Click the Map.
7. To create the right TRP:
    1. Click the right TRP "Click Here for Map Input" button.
    2. Click the Map.

8. Use the default speed and alternate firing position settings. (You can change them (optional). Ignore the Trigger and Secondary Battle Position fields. See Section E.10.1 [Trigger Line in Occupy Position], page 239.
9. Click **Done** in the task editor.
10. Issue the On Order.

B.1.10 Assault Frame

When you assign the **Assault** task frame, you must specify an objective. This frame tells a ground unit to enter line formation and move (40 KPH default speed) towards the enemy objective. Fire permission is set to "Free". When the unit reaches the assault objective, ModSAF creates a battle position line for the unit to occupy.

The task frame has two editable tasks: Assault and React-Air. While executing this task frame, only a reaction to air vehicle detection or attack can occur.

An assault can result from assignment of the Assault frame or or it can result from a reaction set by the **Actions-on-Contact** task. If the Assault is part of a reaction, the unit continues its previous mission when the enemy is defeated. If the Assault is an assigned mission, the unit occupies a battle position.

Use the following procedure to create an Assault task frame:

1. Select **Assault**. The Assault task editor appears.
2. Click on the objective (line, area, point, or text graphic) if it is already created. Otherwise, create an objective by clicking in the Map.
3. Edit the other Assault task parameters (optional).
4. Click **Done** on the Assault task editor.

B.1.11 Overwatch Movement Frame

You can assign the **Overwatch Movement** task frame to a small ground unit to instruct it to move cross-country in an overwatch fashion. When you assign it, you must specify a route (a line, point, or text).

Overwatching divides the unit into two "functional" groups; only one group moves at a time. Whenever a group is traveling along the route, the other group (referred to as the support group) is executing an Occupy-Position task, monitoring the traveling section and watching for enemy vehicles. This method of travel is useful during reconnaissance missions. See Section C.3 [Overwatch-Move Task], page 193.

The task frame has several editable tasks: Overwatch-Move, Actions-on-Contact, React-Air, and React-to-Indirect-Fire . While executing this frame, the unit monitors the battlefield for a reaction-triggering situation (enemy contact, indirect fire, and aircraft detection).

Use the following procedure to create an Overwatch Movement frame:

1. Select **Overwatch Movement**. The Overwatch-Move task editor appears.
2. Click in the Map to create a destination point or select a graphic. To create a new route, click the Line button; place the line, click **Done** in the Line editor.
3. When necessary edit the other task parameters (such as speed, formation, and movement type).
4. Click **Done** in the task editor when you are finished editing.

B.1.12 Traveling Overwatch Frame

You can assign the **Traveling Overwatch** task frame to a small ground unit to instructs it to move cross-country in a traveling overwatch fashion. When you assign it, you must specify a route (a line, point, or text).

Overwatching divides the unit into two "functional" groups; a traveling group that moves out in front and a support group that follows behind.

The task frame has several editable tasks: Traveling-Overwatch. Actions-on-Contact, React-Air, and React-to-Indirect-Fire . While executing this frame, the unit monitors the battlefield for a reaction-triggering situation (enemy contact, indirect fire, and aircraft detection).

To view the Traveling Overwatch frame, do the following:

1. Create an M1 platoon and assign it a Traveling Overwatch frame, using a line for the route and using all the defaults.
2. Issue the On Order to begin the Traveling Overwatch.
3. Click the User Preferences button and click "Speed" to show vehicle speeds on the Map.

4. Choose "Show As..Platoon Icons" from the Menu Bar.

   NOTE: You should see three M1 platoon icons: one for the unit, one for the support group and one for the traveling group.

5. Choose "Show As..Vehicles".

   NOTE: You should see the planning graphics (drawn purple in the Map) for the Prep-Occupy-Position task as the support group moves into position. The Overwatch Position should be approximately 500 meters down the route and the Engagement TRP should be straight out in front of the support group.

   NOTE: When the traveling group crosses the Overwatch Position, the support group will move to follow the traveling group.

6. Click the User Preferences button and click "Speed" to disable the display of speeds.

B.1.13 Withdraw Frame

Withdraw moves a unit away from the enemy, and tells the unit to perform the Occupy-Position task until it receives another order. When you assign this frame, you must specify a route (a point to which the unit quickly moves to before occupying a position). If a line is specified in place of a withdraw point, ModSAF uses the line as a battle position and calculates a withdraw point. Note: Vehicles in a unit are not required to keep formation.

Armored vehicles withdraw in reverse if the enemy is seen; otherwise, they move in normal forward gear. If the enemy is no longer visible, an armored vehicle turns to complete the withdrawal in forward gear. (Once it transitions from reverse to forward, it remains in forward even if the enemy reappears.) Unarmored vehicles use forward gear to reach the withdraw point.

All vehicles with munitions and permission to fire can shoot while moving to the withdraw point. Vehicles do not fire "stop to shoot" weapons (such as the TOW missile) but use suppression fire. By using suppression fire, the vehicle "remembers" enemy position for 30 seconds after the enemy disappears. If the disappearing target is moving, the withdrawing vehicle calculates the most likely location of the target before it fires.

All vehicles occupy a position when they reach the withdraw point. The occupy position is in the direction of the enemy's center of mass. If the enemy is not detected at that time, the area to occupy is in the direction of the initial withdraw position. The vehicles occupy positions unless instructed otherwise.

The task frame has two editable tasks: Withdraw and React-Air. While executing this task frame only a reaction to enemy air vehicles can occur.

Use the following procedure to create a Withdraw task frame:

1. Select **Withdraw**. The Withdraw task needs a destination point or route.
2. Create a destination point by clicking the Map, or supply a point or a route that has already been created. To create a new route, click the Line button, place the line, and click **Done** on the Line editor.
3. Edit the other task parameters if necessary.
4. Click **Done** on the Withdraw task editor when finished.

B.1.14 Breach Frame

You can assign the **Breach** task frame to a ground vehicle or a small ground unit. When you assign this task frame you must specify a route (a line graphic).

Breaching divides a unit into two functional groups: an occupy group and a travel group. The occupy group performs an occupy position while the travel group moves through the area. When the travel group stops, they occupy position. The previous occupy group then moves along the same route. Mines explode if encountered. The vehicles move at 7 KPH in a close staggered-column formation along the given route. DI (if present) mount their companion vehicles before passing through the minefield.

When a vehicle breaches a minefield. it can drop objects behind itself (called breach lane markers) to mark its path. This lets other vehicles see the safe route.

The task frame has one editable task: Breach. While executing this task frame, reactions (to air attack, enemy contact, and indirect fire) do not occur.

B.1.15 Attack by Fire Frame

You can assign the **Attack by Fire** task frame to tell a unit to advance to a battle position. Once the vehicles are in position, they can shoot at the enemy (as long as they have munitions and permission to fire). Shooting uses the alternating fire technique. A call for indirect fire is reported by radio at the beginning of the attack. A spot report is sent when the attack is over.

Usually a ground unit halts while waiting for you to issue On Order authorization. This task frame does not do that; rather, it moves the vehicles to battle positions while waiting for your On Order.

The task frame has two editable tasks: **Occupy-Position** and **React-Air**. While executing this task frame, only the air attack reaction can occur.

B.1.16 Concealment Frame

The **Concealment** task frame is similar to the Hasty Occupy Position task frame except that it attempts to find concealed, or partially hidden, positions rather than covered (hull defilade) positions. When you assign it, you must specify a route (a line, point, or text).

The task frame has these editable tasks: Concealment, Occupy-Position, Actions-on-Contact, React-Air, and React-to-Indirect-Fire. The Concealment task ends when the subordinate vehicles have reached the desired positions. While executing this task frame, the enemy contact, indirect fire, and air attack reactions can occur.

Use the following procedure to create a Concealment task frame:

1. Select **Concealment**. The Concealment task editor appears.
2. Create a destination point by clicking in the Map. To supply a point or a route that has already been created, select it from the Map. To create a new route, click the Line button, place the line, and click **Done** in the Line editor.
3. Edit the other task parameters (optional).
4. Click **Done** on the Concealment task editor when complete.

B.1.17 Delay Frame

The **Delay** task frame lets a unit (currently only a platoon unit) perform a delay maneuver. When assigning this task frame, you must enter at least one of four alternate battle positions. The Delay automatically ends when the unit reaches the last battle position.

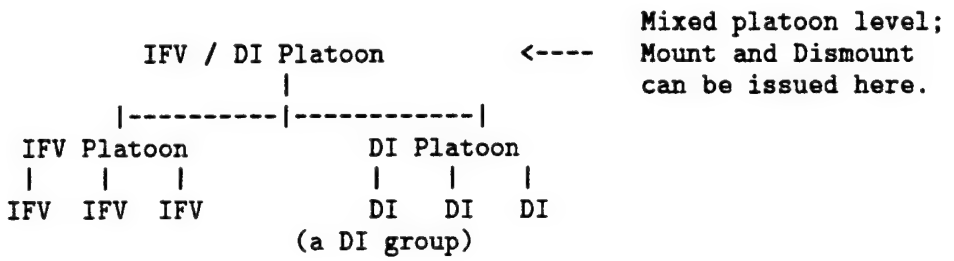
Delay divides the unit into two functional groups who perform withdraws to the alternate battle positions in a nonbounding fashion. For example, one functional group withdraws to the battle position while the second functional group stays to fire at the enemy. When the first group completes the withdraw, the second group begins to withdraw to the same battle position occupied by the first group. Once the second group is finished occupying the battle position, the first group withdraws to the next battle position, and so on.

Parametric Delay data, currently set at 1500 meters, specifies the delay distance. This distance indicates how close the center of mass of the enemy vehicles must be to the platoon leader of the delaying unit for the unit to withdraw to the next battle position.

The task frame has one editable task: Delay. A unit does not react to enemy contact, indirect fire, or air attack while executing this task frame.

B.1.18 Mount Frame

A unit has associated Dismounted Infantry (DI) when the name includes <IFV>/DIGroup Platoon (where Infantry Fighting Vehicle (IFV) can be M2, BMP, MARDER, etc.). When you create this type of unit, its associated DI appear in the dismounted state and its unit hierarchy is similar to the following:



The DI maintain a one-on-one association with an Infantry Fighting Vehicle in its unit. This association allows the DI to be "smart"–they know whether they are mounted, and if so, to what vehicle.

Assign the Mount task frame at mixed-unit level as shown in the figure. The following behavior occurs:

1. ModSAF generates a movement task (Pick Up) enabling the IFV that is associated with each DI group to move to that DI position. If the vehicle is otherwise occupied, that frame is suspended until the vehicle reaches its destination.
2. When all the IFVs arrive, each DI group mounts its vehicle and disappears from the Map.
3. If the DI cannot mount (due to an IFV being killed or having a mobility failure), a radio message appears saying there is no IFV to mount.

The Mount task frame consists of three editable tasks: Actions-on-Contact, React-Air, and React-to-Indirect-Fire. While executing this task frame, the unit can react to ground enemy contact, an air attack, or indirect fire.

B.1.19 Dismount Frame

The **Dismount** task frame should be assigned at the entity- or mixed-unit level. This frame instructs an IFV unit to halt and dismount a group of DI subordinates. If the unit is moving cross-country, the vehicles halt in formation. If the unit is on a road, the vehicles halt in a herringbone formation.

The following behavior occurs for a Dismount frame:

1. ModSAF generates a Halt task to stop the IFV associated with the DI Platoon. If the vehicle is doing something else at the time, that frame is suspended until the vehicle stops.
2. When the IFVs halt, the DI group associated with each IFV dismount and appear on the Map.

The Dismount task frame consists of three editable tasks: Actions-on-Contact, React-Air, and React-to-Indirect-Fire. While executing this task frame, the unit can react to ground enemy contact, an air attack, or indirect fire.

B.1.20 Multiple Launch Rocket System (MLRS) Frame

The Multiple Launch Rocket System (MLRS) task frame is specifically designed for the "blue" M270 family of artillery vehicles. When you assign it, you must specify a point from which to fire, and a point at which to hide. A fire point should be within 100 meters of the vehicle's location and the hide point should be approximately 1 KM from the fire point.

After assigning this frame, you can issue a Fire Order or Fire Request using the Fire Support tool. When the MLRS vehicle receives the order to fire, it loads the ammunition included on the vehicle, moves to the firing position, and fires. After firing, the MLRS vehicle drives to the hide point.

Note: Currently, MLRS vehicles are considered "one shot" – all their munitions are expended during the mission.

The task frame has two editable tasks: MLRS and React-Air. While executing this task frame, an MLRS vehicle reacts to an air attack but does not react to enemy contact or indirect fire.

To assign an MLRS task frame:

1. Create an M270_<ammo> MLRS vehicle. Use M270_GAT2, M270_M26, or M270_M77.
2. Use the execution matrix to assign the **MLRS** task frame to the vehicle. The MLRS task editor appears.
3. Click the firing and hiding points if they are already created. Otherwise, create them by placing points on the Map. Edit the other MLRS task parameters as needed.
4. Click **Done** on the MLRS task editor when you are finished.
5. Issue the On Order.
6. You can now issue a Fire Order or Fire Request using the Fire Support tool.

B.1.21 Supply Frame

Assign the **Supply** task frame to a ground resupply vehicle such as an M977, M978, URAL375C, or URAL 375F. When you assign it, specify a point at which to resupply. The resupply area consists of a circle whose center is the point at which you resupply. Its radius is a parameter (default is 500 meters).

Note: the M977 and the URAL375C do not have any ammunition when created. The battlemaster can edit the vehicle to supply it with munitions. The M978 and the URAL375F are loaded with fuel when created.

The task frame has one editable task: Supply. While executing this task frame, a supply vehicle does not react to enemy contact, indirect fire, or air attack.

Protocol support for combat service support (CSS) allows supply protocol data units to communicate through the network. This capability is integrated with the Supply task.

To view the Supply mission:

1. Select **New Scenario**.
2. Create an M1 platoon with a fuel supply of 100 gallons less than the default.
3. Create an M978 Fuel Supply HEMMT in the vicinity (approximately 500m) of the M1 platoon.

4. Assign the Supply frame to the M978. Select a supply point near the center of the M1 platoon. (Note: the specified point and the radius select all vehicles within that area for resupply.)
5. Assign the On Order. The M978 moves to the supply point and iteratively visits each vehicle to transfer fuel. The fuel is incremented on the receiving vehicle and decremented on the supply vehicle. When the supply vehicle has resupplied all the vehicles, it halts and waits for subsequent commands.

B.1.22 Service Station Frame

Assign the **Service Station** task frame to a ground unit such as an M1 platoon to tell its vehicles to perform a fuel resupply, one vehicle at a time.

The task frame has one editable task: Service-Station. While executing this task frame, a unit does not react to enemy contact, indirect fire, or air attack.

Protocol support does permit remote service station resupply in addition to local service station resupply.

To view the Service Station mission:

1. Select **New Scenario**.
2. Create an M1 platoon with a fuel supply of 100 gallons per vehicle.
3. Create an M978 Fuel Supply HEMMT in the vicinity (approximately 500m) of the M1 platoon.
4. Assign the Service Station frame to the M1 platoon. Select the M978 as the supply vehicle.
5. Assign the On Order. One-by-one, each vehicle in the M1 platoon moves to the M978 Fuel HEMMT, gets refueled, and then returns to its original position.

B.1.23 SupplyRWA Frame

You can assign the **SupplyRWA** task frame to a M978 vehicle, a M979 vehicle, or an M978/M979 FARP resupply unit. When you assign it, you must specify a point about which to resupply. The resupply area is a circle whose center is the point you supply and whose radius is a parameter (default is 750 meters).

The task frame has one editable task: Unit-Supply-RWA. While executing this task frame, a resupply unit does not react to enemy contact, indirect fire, or air attack. See Section C.21 [Unit-Supply-RWA Task], page 205.

To view the SupplyRWA mission, do the following:

1. Select **New Scenario**.
2. Create a AH-64 Flight-of-2 unit with a fuel supply of four gallons.
3. Create a M978/M979 Farp unit in the vicinity (within approx. 500m) of the AH-64 unit.
4. Assign the M978/M797 Farp unit the SupplyRWA frame. Select a resupply location near the AH-64 unit. (Note: the specified point and the radius will select all vehicles within that area for resupply.)
5. Assign the On Order. The M978/M797 FARP unit drives to the supply point and then iteratively visits each vehicle to transfer fuel. The fuel is correctly incremented on the receiving vehicle and decremented on the supply vehicle. When the supply vehicle has resupplied all the vehicles, it returns to its base and waits for subsequent commands.

B.1.24 Cross-leveling Frame

Cross-leveling equalizes a supply reserve among vehicles in a unit. When you assign the Cross-leveling task frame, you must specify a point where the cross-leveling should occur. The vehicles travel to the cross-level point before transferring supplies.

The task frame has one editable task: Cross-leveling. While executing this task frame, a unit does not react to enemy contact, indirect fire, or air attack.

To view the Cross-leveling mission:

1. Select **New Scenario**.
2. Create an M1 platoon.
3. Edit the first vehicle in the M1 platoon and reduce its fuel supply by 400 gallons.
4. Select the Cross-leveling frame in the Unit Operations editor as the platoon mission.
5. Click in the Map to select an open cross-leveling area in the vicinity.
6. Keep **Fuel** as the "Supply To Cross-level" choice. (Changing to **Most unbalanced non-fuel munition** tells the task to ignore fuel and instead transfer the ammunition that is most-unbalanced (as a percentage of vehicle capacity).)

7. Select On-Order to start the mission. The vehicles form a circle around the center of the area, and meet side-by-side in pairs to transfer supplies. Since fuel was specified, the vehicles return to the circle with equal amounts of fuel.

B.1.25 Tow Frame

You can assign the M88A1 tow vehicle a **Tow** task frame to tell it to tow a disabled vehicle to a repair area. Note: Currently, the M88A1 is the only vehicle whose parameter file (US_M88A1_params.rdr in common/src/ModSAF/entities) is configured to handle the SM_UTow and SM_Vtow tasks.

When assigning the Tow task frame, you must specify the disabled vehicle and a point where it should be towed to. The recovery vehicle travels to a point in front of the disabled vehicle and backs up. It then tows the vehicle to the specified repair location.

The Tow task frame consists of four editable tasks: Tow, Actions-on-Contact, React-Air, and React-to-Indirect-Fire. While executing this task frame, a tow vehicle can react to enemy contact, indirect fire, or air attack.

Note: Towing does not work when running with the SIMNET protocol.

To view the Tow mission:

1. Select **New Scenario**.
2. Create an M1 vehicle.
3. Use the Artillery button to drop a 500 lb bomb adjacent to the M1. Repeatedly drop a bomb until the M1 suffers a mobility or firepower failure. (A bent hull indicates a mobility failure and a bent gun tube indicates a firepower failure.)
4. Create an M88A1 recovery vehicle 1 km away from the M1.
5. Select the Tow frame in the Unit Operations editor as the M88A1 mission.
6. Click on the disabled M1 in the Map to select the vehicle to tow.
7. Click in the Map to select a towing destination point 2 kms away from the M1.
8. Select On-Order to start the mission. The M88A1 should move to the M1 area and back up to the M1. It should then tow the disabled M1 to the tow destination point.

B.1.26 Repair Frame

You can assign the German-M113-Skorpian or the M113-Engineer vehicle a **Repair** task frame to tell it to try to fix a disabled vehicle. The repair vehicle works with a recovery vehicle so that the disabled vehicle can be towed away if the on-site repair fails.

When assigning the Repair task frame, you must specify the disabled vehicle, the towing vehicle (a US M88A1), and the Unit Maintenance Collection Point (UMCP). The UMCP is the location to tow to when necessary.

The repair vehicle travels to the disabled vehicle and determines the extent of damage. If the damage is catastrophic, no on-site repair is attempted and the specified tow vehicle takes the damaged vehicle to the UMCP. Otherwise, a repair clock, whose limit comes from the SM_VRepair parametric data ("UMCP_repair_time"), is set and an on-site repair is attempted. If the time limit elapses before the repair is complete, on-site repair is cancelled and the specified recovery vehicle moves to the disabled vehicle and tows it to the UMCP. The repair vehicle's "vehicle repair" status message tells you whether the repair can be made.

The Repair task frame consists of four editable tasks: Repair, Actions-on-Contact, React-Air, and React-to-Indirect-Fire. While executing this task frame, a repair vehicle can react to enemy contact, indirect fire, or air attack.

Note: Towing does not work when running with the SIMNET protocol.

To view the Repair mission:

1. Select **New Scenario**.
2. Create an M1 vehicle.
3. Use the Artillery button to drop a 500 lb bomb adjacent to the M1. Repeatedly drop a bomb until the M1 suffers a mobility or firepower failure. (A bent hull indicates a mobility failure and a bent gun tube indicates a firepower failure.)
4. Create an M88A1 recovery vehicle and a German-M113-Skorpian repair vehicle 1 km away from the M1.
5. Select the Repair frame in the Unit Operations editor as the M113 mission.
6. Click on the disabled M1 in the Map to select the vehicle to repair.
7. Click on the M88A1 in the Map to specify the tow vehicle.
8. Click in the Map 2 kms away from the M1 to select a towing destination (UMCP) point.

9. Select On-Order to start the mission. The M113 should move to the M1 and attempt the repair. Examine the "Vehicle Repair" status message for the M113. If the repair can't be made, the M88A1 should move to the M1 and then tow it to the UMCP.

B.1.27 Attach Frame

You can assign a mine breaching vehicle (an M1, M1A1, M1A2, or GRIZZLY) the **Attach** task frame to tell it to attach a FWMP plow component. Note: Only the GRIZZLY mine breaching vehicle has an attached plow when it is created. You can assign an engineering vehicle (an AVLB) the **Attach** task frame to tell it to attach a bridge component.

When assigning the Attach task frame, you must specify a site that the vehicle will travel to before performing the attachment operation.

The Attach task frame consists of four editable tasks: Attach/Detach, Actions-on-Contact, React-Air, and React-to-Indirect-Fire. While executing this task frame, a vehicle can react to enemy contact, indirect fire, or air attack.

To view the Attach mission:

1. Select **New Scenario**.
2. Create an M1 vehicle.
3. Select the Attach frame in the Unit Operations editor as the M1 mission.
4. Click in the map to specify an attachment site.
5. Click Done in the Attach/Detach task editor.
6. Select On-Order to start the mission. The M1 should move to the attachment site and attempt to attach a plow to the M1 chassis.

B.1.28 Detach Frame

You can assign a mine breaching vehicle (an M1, M1A1, M1A2, or GRIZZLY) the **Detach** task frame to tell it to detach a FWMP plow component. You can assign an obstacle breaching vehicle (an AVLB) the **Detach** task frame to tell it to detach a bridge component.

When assigning the detach task frame, you must specify a site that the vehicle will travel to before detaching its bridge or plow component.

The Detach task frame consists of four editable tasks: Attach/Detach, Actions-on-Contact, React-Air, and React-to-Indirect-Fire. While executing this task frame, a vehicle can react to enemy contact, indirect fire, or air attack.

To view the Detach mission:

1. Select **New Scenario**.
2. Create an AVLB vehicle and assign it a Detach mission. Note: An AVLB is created with a bridge component automatically attached.
3. Click in the map to specify a detachment site.
4. Click Done in the Attach task editor.
5. Select On-Order to start the mission. The AVLB should move to the detach site and attempt to remove the bridge from the AVLB chassis.

B.1.29 Plow Breach Frame

You can assign a Plow Breach frame to a mine breaching vehicle (an M1, M1A1, M1A2, or GRIZZLY) to tell it to position its plow and then breach a minefield. A vehicle must have a plow attached before it can breach a minefield.

When assigning the Plow Breach task frame, you must specify a route.

The Plow breach task frame consists of one editable tasks: Plow-Brch. While executing this task frame, a vehicle does not react to enemy contact, indirect fire, or air attack.

To view the Plow Breach mission:

1. Select **New Scenario**.
2. Create an area minefield.
3. Create a route through the minefield.
4. Create an M1A2 vehicle near the route and issue it an Attach mission. See Section B.1.27 [Attach Frame], page 168.
5. Once the plow is attached, interrupt the Attach mission by replacing it with a Plow Breach mission.
6. The Plow Brch task editor appears to ask for a route.. Use the Line button to create a route through the minefield.

7. Click Done in the Plow Brch task editor.
8. Select On-Order to start the mission. The M1A2 automatically positions its plow and breaches the minefield.

B.1.30 Brdg Deploy Frame

Assign a Brdg Deploy frame to an AVLB vehicle to tell it to drive to a deploy point, position its attached bridge component at the deploy point, and then drive to the move away (clear bridge) point. A vehicle must have a bridge attached before it can deploy a bridge across a simulated ditch.

When assigning the Brdg Deploy task frame, you must specify a deploy point and a move away point.

The Brdg Deploy task frame consists of one editable task: Brdg-Deploy. While executing this task frame, a vehicle does not react to enemy contact, indirect fire, or air attack.

To view the Brdg Deploy mission:

1. Select **New Scenario**.
2. Turn on display of the Message Log.
3. Create a line whose style is ATDitch (1) or ATDitch (2). These line styles create simulated ditch barriers.
4. Create an AVLB vehicle near the ditch and issue it a Brdg Deploy mission.
5. Click in the map near a ditch segment to specify the deploy point.
6. Click in the map at a location in front of the ditch to specify the move away location.
7. Click Done in the Brdg-Deploy task editor.
8. Select On-Order to start the mission. The AVLB (with bridge component attached) will move to the deploy point, deposit the bridge, and then travel to the move away location.

B.1.31 Brdg Retrieve Frame

Assign a Brdg Retrieve frame to an AVLB vehicle to tell it to drive to a point and retrieve a bridge component. Only an AVLB vehicle that does NOT have a bridge stowed can retrieve a bridge.

When assigning the Brdg Retrieve task frame, you must specify a bridge to retrieve.

The Brdg Retrieve task frame consists of one editable task: Brdg-Retrieve. While executing this task frame, a vehicle does not react to enemy contact, indirect fire, or air attack.

B.1.32 Position Part Frame

You can assign a Position Part frame to a mine breaching vehicle (such as the M1, M1A1, M1A2, or GRIZZLY vehicle) to tell it to position its attached component (plow) up or down. This is useful when a mine breaching vehicle needs to follow (using the Follow Vehicle frame) a lead vehicle that is performing a Plow Breach mission. The Plow Breach mission automatically instructs a vehicle to deploy its plow, but in a Follow Vehicle mission, you need to tell the vehicle to deploy its plow.

When assigning the Position Part task frame, you must specify a position (deployed or stowed).

The Position Part task frame consists of one editable task: Position-Part. While executing this task frame, a vehicle does not react to enemy contact, indirect fire, or air attack.

B.2 Company Task Frames

ModSAF uses company-level formations, targeting coordination, and tasks to support tactics for ground companies. These tactics are encapsulated in the company task frames that support behavior such as: march in formation, roadmarch, attack, and occupy and defend a position.

While the company is executing a frame, it monitors the battlefield for a reaction-triggering situation. If a company detects that situation it can react as a single unit. When a ground enemy is encountered, a company can perform the reactions specified in its `Actions-on-Contact` task. When enemy aircraft is detected, the company's vehicles can scatter in different directions unless the vehicles are in a defensive (battle) position.

B.2.1 Co March Frame

`CO March` instructs a company to travel on either a cross-country or a road route. During movement, the extra vehicles (such as the company commander, XO, and others) are functionally organized into the platoons that stay in formation. At the end of the route, the extra vehicles (the leaders) revert to the task organization that the unit started with. When you assign this task frame, you must specify a route or destination point.

This task frame consists of three editable company tasks: March, Actions-on-Contact, and React-Air. While executing this task frame, a company can react to air or ground enemy contact, but does not react to indirect fire.

B.2.2 Co Road March Frame

`Co Road March` instructs a company to perform a road march (vehicles stay on the road when traveling on a road segment). When you assign this task frame, you must specify a route or destination point.

This task frame consists of three editable company tasks: March, Actions-on-Contact, and React-Air. While executing this task frame, a company can react to air or ground enemy contact, but does not react to indirect fire.

B.2.3 Co Halt Frame

`Co Halt` instructs a company to stop moving. The Halt frame does not end. Whenever you use a Halt frame in an execution matrix and the transition to the next phase is by a `Continue` transition, the frame for the next phase must have an On Order.

This task frame consists of two editable company task: Actions-on-Contact and React-Air. While executing this task frame, a company can react to air or ground enemy contact but does not react to indirect fire.

B.2.4 Company Attack Frame

When you assign the `CO Attack` task frame, you must specify an objective to attack. The company advances (at 40 KPH default speed) in line formation to the objective with fire permission set to "free". When the company reaches the attack objective its vehicles occupy a battle position at that location facing the direction of the attack. The company can also stop before reaching the objective and occupy a position if the number of casualties is too high. This task frame is similar to the Assault task frame for ground unit and vehicles.

This task frame consists of one editable company task: Attack. While executing this task frame, a company does not react to enemy contact, indirect fire, or an air attack.

B.2.5 Co Withdraw Frame

When you assign the `CO Withdraw` task frame to a ground company, you must specify to which point it can withdraw. ModSAF uses this point to generate final withdraw points for each platoon. Vehicles in the company that are not part of a platoon are functionally organized to a platoon. The platoons withdraw one at a time. When the withdrawing platoon occupies position, the next platoon withdraws, and so on, until the platoons reach their final points.

This task frame consists of one company editable task: Withdraw. While executing this task frame, a company reacts to an air attack but does not react to enemy contact or indirect fire.

To view the company withdraw:

1. Select `New Scenario`.

2. Create a company.
3. Task the company by choosing "Withdraw" from the list of available frames. Click in the map to supply the withdraw point. Vehicles that are not a part of a platoon are functionally organized into a platoon. Each platoon then withdraws to its final point (or intermediate point if the withdraw point is distant) and then occupies a position.

B.2.6 Co Assembly Area Frame

The **CO Assembly Area** task frame tells a company to advance to, and then occupy, an assembly area. When you assign this task frame you must specify a position that a unit can assemble around. To supply the point, select or create a point on the Map. The assembly area is a circle whose center is the point you supply. Its default radius is 700 meters.

Company platoons provide 360 degree coverage. ModSAF creates N battle positions providing 360 degree coverage. N is the number of subordinate units. ModSAF creates target reference points (TRPs) along with battle positions.

This task frame consists of two editable tasks: Assembly-Area and Actions-on-Contact. While executing this task frame, a company does react to ground enemy contact.

To view a Company Assembly Area task frame:

1. Select **New Scenario**.
2. Create a T72M company.
3. Assign the company the Assembly Area frame. Select a point in the center of the company. After the On Order is given, the company breaks up and moves toward the positions. The platoons should then form a triangle that provides 360 degrees of coverage.

B.2.7 Co Hasty Occupy Position Frame

When you assign the CO **Co Hasty Occupy Position** task frame, you must supply a battle position and three target reference points (TRPs): left, right, and engagement area TRP. To specify a battle position, select a line from the map or create one using the Line Button. To specify a TRP, select a point from the map or create one using the Point Button.

ModSAF separates the battle position into N segments of equal length, where N is the number of platoons in the company. ModSAF then creates left and right TRPs for each platoon. The company

commander and executive officer are functionally organized into one platoon each. Each platoon moves to its battle position and receives its calculated left and right TRP with the unmodified engagement area TRP.

This frame has two editable tasks: Occupy-Position and Actions-on-Contact. While executing this task frame, a company can react to ground enemy contact, it does not react to indirect fire, or an air attack.

To view a Company Hasty Occupy Position:

1. Select **New Scenario**.
2. Create an M1 company.
3. Create a battle position line for the company to occupy.
4. Assign the M1 company the Hasty Occupy Position using the execution matrix in the Unit Operations editor. You need not issue an On Order since this frame has set the preparing task set so that the unit advances to the battle position rather than halts while waiting for authorization. The CC and XO each join a platoon and all platoons move toward the battle position without any vehicles crossing each other.

B.2.8 Co Prebattle March Frame

The **CO Prebattle March** task frame can be assigned only to an enemy (red) ground company. When you assign this task frame, you must specify a route (a point, line, or text control measure). The default formation is a line and the default subformation is a column; however, you can change both.

This frame has two editable tasks: March and Actions-on-Contact. While executing this task frame, a company can react to ground enemy contact; it does not react to indirect fire or an air attack.

B.3 Battalion (Bn) Task Frames

Battalion task frames can be assigned to the M1 Battalion. Reactions have not been implemented on the battalion level. Therefore, a battalion mission does not react to enemy contact, indirect fire, and air attack.

B.3.1 Bn March Frame

Bn March can be assigned to an M1 battalion. When you assign this task frame, you must specify a route (a point, line, or text control measure). A default formation and subformation are provided; however, you can change both.

To view a Bn March:

1. Select **New Scenario**.
2. Create an M1 battalion.
3. Create a cross country line for the route.
4. Assign the M1 battalion the Bn March frame on the route using the execution matrix in the Unit Operations editor. Issue the On Order. The battalion should move along the selected route.

B.3.2 Bn Halt Frame

Bn Halt can be assigned to an M1 battalion. This frame instructs a battalion to stop moving. The Halt frame does not end. Whenever you use a Halt frame in an execution matrix and the transition to the next phase is by a **Continue** transition, the frame for the next phase must have an On Order.

B.4 Fixed Wing Aircraft (FWA) Task Frames

FWA ground attacks require an aircraft with a visual sensor component. The A10, F16D, and the SU-25 are simulated with a visual sensor; the F14D, Mig 27, and the Mig 29 have a radar sensor. Therefore, although you can assign a radar-only aircraft an Attack frame, it cannot shoot ground targets.

B.4.1 Ingress Frame

The **Ingress** task frame notifies an FWA unit to fly a route, then orbit or land at the end of the route. An FWA follows the waypoints of a line or goes directly to a point or text. While performing the Ingress task frame, an FWA (with a visual sensor component) automatically attacks a target that satisfies the requirements of its Targets-of-Opportunity task.

The Ingress task frame consists of three editable tasks: FWA-Fly-Route, Bingo-Fuel, and Targets-of-Opportunity.

The movement type can be one of the following:

- Low Level – Follows at a constant altitude, only increasing altitude to fly over an obstacle.
- Contour – Follows the contour of the earth.

To create an Ingress task frame:

1. Select **Ingress**. The FWA-Fly-Route task editor appears in the Editor area.
2. Click the route if already created. Otherwise, create a destination point or route. To create a destination point, click in the Map. To create a route, click the Line button, place the route, and click **Done** on the Line editor. Edit the other task parameters (optional).
3. Click **Done** on the FWA-Fly-Route task editor.
4. Click a refuel point, if already created, to supply a refuel location for the Bingo-Fuel task. Otherwise, create a point by clicking in the Map. Edit the other Bingo-Fuel task parameters (optional).
5. Click **Done** on the Bingo-Fuel task editor.

B.4.2 Attack Ground Target Frame

The **Attack Ground Target** task frame notifies an FWA unit to monitor the battlefield, and search for an opportunity to launch an attack on ground targets. When you assign this task frame you are required to specify a target location and a refuel point.

The Attack Ground Target task frame consists of two editable tasks: Attack-Ground-Target and Bingo-Fuel.

To create an Attack Ground Target task frame:

1. Select the **Attack Ground Target** frame. Since this frame needs a target location, a task editor appears.
2. Click the target point if already created. Otherwise, you need to create the target point by clicking the Map to supply the target location. Edit the other task parameters (optional).
3. Click **Done** on the Attack-Ground-Target task editor.
4. Click the refuel point, if already created, to provide a refuel location. Otherwise, you create a refuel location by clicking in the Map. Edit the other task parameters (optional).
5. Click **Done** on the Bingo-Fuel task editor.

B.4.3 Sweep Frame

The **Sweep** task frame can be assigned only to a vehicle, not a unit. This task is designed for an FWA with a radar sensor which includes the F14D, the Mig 27, and the Mig 29. This task frame, which is similar to a scouting mission, instructs a plane to fly a route, then orbit at the end of the route. It is capable of following the waypoints of a line, or of going directly to a point or text.

When you assign this frame, you must specify a route and a refuel point. While executing this task frame, an FWA runs the Commit-Criteria task searching for an opportunity to perform beyond visual range (BVR) air-to-air combat. The vehicle automatically performs an air-to-air intercept if it locates a target that satisfies the requirements of the Commit-Criteria task.

The Sweep task frame consists of three editable tasks: Follow-Route, Bingo-Fuel, and Commit-Criteria.

To create a Sweep task frame:

1. Click **Sweep**. The Follow-Route task editor appears in the Editor area.
2. Click the route if already created. Otherwise, click the Line button to create the route. Place the route and click **Done** on the Line editor. Edit the other task parameters (optional).
3. Click **Done** on the Follow-Route task editor.
4. Click on the point (if already created) to provide a refuel location for the Bingo-Fuel task. Otherwise, create a point by clicking in the Map. Edit the other task parameters (optional).
5. Click **Done** on the Bingo-Fuel task editor.

B.4.4 Combat Air Patrol (CAP) Frame

The **Combat Air Patrol** (CAP) task frame can be assigned only to a vehicle, not a unit. This task frame is designed for an FWA with a radar sensor including the F14D, the Mig 27, and the Mig 29. When you assign this frame, you must specify a CAP location (a point or text control measure) and a refuel point.

Use CAP to monitor an area since it instructs the aircraft to fly in a racetrack pattern around a CAP point.

While executing this task frame, an FWA runs the Commit-Criteria task searching for an opportunity to perform BVR air-to-air combat. A vehicle automatically perform an air-to-air intercept if a target satisfies the requirements of the Commit-Criteria task.

The Combat Air Patrol (CAP) task frame consists of three editable tasks: CAP, Bingo-Fuel, and Commit-Criteria.

To create a CAP task frame:

1. Click **CAP** in the list of available frames. The CAP task editor appears.
2. Click the patrol point if already created. Otherwise, create the CAP point by clicking in the Map. Edit the other task parameters (optional).
3. Click **Done** on the CAP task editor.
4. Provide a refuel location by clicking on the refuel point (if already created (a point or text control measure is acceptable)). Otherwise, create the point by clicking in the Map. Edit the other task parameters (optional).
5. Click **Done** on the Bingo-Fuel task editor.

B.4.5 Return to Base Frame

The **Return to Base** task frame can be assigned only to a vehicle, not a unit. This task frame instructs an aircraft to land and resupply at the base location.

The Return to Base task frame consists of one editable task: Return-to-Base.

To create a Return to Base task frame:

1. Click **Return to Base** in the list of available frames. The Return-to-Base task editor appears in the Editor area.
2. Click the base point or the route if already created. Otherwise, create a base point by clicking in the Map. Edit the other task parameters (optional).
3. Click **Done** on the Return-to-Base task editor.

B.4.6 Egress Frame

The **Egress** task frame is for an FWA vehicle or unit. When you assign this task frame, you must specify a route and a refuel point.

While executing this task frame, the Targets-of-Opportunity task monitors the battlefield for an opportunity to launch an attack on ground targets. FWAs need a visual component to attack ground targets of opportunity.

The Egress task frame consists of three editable tasks: FWA-Fly-Route, Bingo-Fuel, and Targets-of-Opportunity.

To create an Egress task frame:

1. Select **Egress** from the list of available frames. The FWA-Fly-Route task editor appears in the Editor area.
2. Click the route if already created. Otherwise, create a destination point or route by clicking in the Map. To create a new route, click the Line button, place the route, and click **Done** on the Line editor. Edit the other task parameters (optional).
3. Click **Done** on the FWA Fly-Route task editor.
4. Click on the point, if already created, to provide a refuel location for the Bingo-Fuel task. Create a point by clicking in the Map. Edit the other task parameters (optional).

5. Click **Done** on the Bingo-Fuel task editor.

B.4.7 Close Air Support (CAS) Mission Frame

The **CAS Mission** task frame lets you call in FWA Close Air Support on enemy locations with the Fire Support tool. This task frame is similar to the Attack Ground Target frame except that you must send an air support message from the Fire Support editor before the aircraft's fire permission is set to "free". See Section E.6.4 [Calling in Close Air Support], page 233.

This frame is appropriate for an A10 vehicle or unit. When you assign this task frame, you must specify a route and a refuel point. While executing this task frame, the Close Air Support task searches the battlefield for an opportunity to launch an attack on ground targets. An FWA must have a visual component to attack ground targets.

The CAS Mission task frame consists of three editable tasks: FWA Fly-Route, Bingo-Fuel, and Close Air Support.

Use the following procedure to create a CAS Mission task frame:

1. Select **CAS Mission** from the list of available frames. The FWA Fly-Route task editor appears in the Editor area.
2. Click the route if already created. Otherwise, create a destination point by clicking the Map. If you want to create a new route, click the Line button, place the route, and click **Done** on the Line editor. Edit the other task parameters (optional).
3. Click **Done** on the FWA Fly-Route task editor.
4. Click the point, if already created, to supply a refuel location for the Bingo-Fuel task. Otherwise, create a refuel location by clicking in the Map. Edit the other task parameters (optional).
5. Click **Done** on the Bingo-Fuel task editor.

B.5 Rotary Wing Aircraft (RWA) Task Frames

RWA can be created as singles or units. Units of RWA can be created in one of several RWA formations including: wedge, line, echelon-left, echelon-right, trail, staggered-left, or staggered-right.

Movement of RWA can be in contour, nap-of-earth (NOE), or low-level flight. Contouring for RWA flight takes tree lines, canopies, and buildings into account. This means that vehicles can safely be created in tree canopies or given routes with waypoints at tree lines.

A unit, whose frame contains one or more reaction-triggering tasks, monitors the battlefield to watch for a situation (such as enemy contact or radar illumination) that can result in a reaction. Both the Radar-Warn-Recvr (aka Radar Warning Receiver) and the React-to-Contact (aka RWA Reactions) are RWA reaction-triggering tasks. Note: The reaction occurs only if the monitoring task is set to enable a reaction. This is the default; however, you can change the setting to disable the reaction.

The Radar-Warn-Recvr task monitors the radar illumination of the unit subordinates. If the task detects illumination while reacting is enabled, the task instructs the vehicles to avoid radar by jinking away from the radar source and then flying at a lower altitude.

The React-to-Contact task monitors the battlefield for enemy. If a target is found that satisfies the unit's rules of engagements, the unit automatically attacks if reacting is enabled. See Section C.39 [React-to-Contact Task], page 215.

B.5.1 RWA Fly Route Frame

The `Fly Route` task frame instructs RWA to fly along a route in various movement types and formations. RWA hover at the end of the route. RWA monitor their supplies to guard against running out of fuel or ammunition. If supplies are low, RWA automatically fly to their FARP point. When you assign this frame, you must specify a route (a point, line, or text control measure) and a FARP point (a point or text).

The Fly Route task frame has four editable RWA tasks: Fly-Route, Unit-FARP, Radar-Warn-Recvr (aka Radar Warning Receiver), and React-to-Contact (aka RWA Reactions). By default this frame's React-to-Contact task and Radar-Warn-Recvr task are both set to react.

To assign a Fly Route task frame:

1. Select `Fly Route` from the list of available frames. The Fly-Route task editor appears in the Editor area.
2. Click on the air route if already created. Otherwise, to create an air route do the following: click the Line button, place the route, and click `Done` on the Line editor. Edit the other task parameters (optional).

3. Click **Done** in the Fly-Route task editor. The Unit-FARP task editor appears in the Editor Area.
4. Click on the FARP (resupply) location (a point or text control measure is acceptable) if already created. Otherwise, click in the Map to create one. Edit the other task parameters (optional).
5. Click **Done** in the Unit-FARP task editor.

B.5.2 RWA Hover Task Frame

The **Hover** task frame instructs an RWA vehicle or unit to stop at its current location at the specified altitude. RWA monitor their supplies to guard against running out of fuel or ammunition. If supplies are low, they automatically fly to their FARP point. When you assign this frame, you must specify a FARP point (a point or text).

The Hover task frame has four editable RWA tasks: Hover, Unit-FARP, Radar-Warn-Recvr (aka Radar Warning Receiver), and React-to-Contact (aka RWA Reactions). By default this frame's React-to-Contact task is set to allow reacting; while its Radar-Warn-Recvr task is set to disable reacting.

To assign a Hover task frame:

1. Click **Hover** in the list of available frames. The Unit-FARP task editor appears in the Editor Area.
2. Click on the FARP (resupply) location (a point or text control measure is acceptable) if already created. Otherwise, click in the Map to create one. Edit the other task parameters (optional).
3. Click **Done** in the Unit-FARP task editor.

B.5.3 RWA Land Task Frame

The **Land** task frame instructs an RWA vehicle or unit to land at its current location. If the RWA are currently on the ground, they remain where they are.

This task frame has two editable RWA tasks: Radar-Warn-Recvr (aka Radar Warning Receiver), and React-to-Contact (aka RWA Reactions). By default this frame's React-to-Contact task is set to allow reacting; while its Radar-Warn-Recvr task is set to disable reacting.

To create a Land task frame:

1. Click **Land** in the list of available frames. No parameters are needed.

B.5.4 RWA Orbit Frame

The **Orbit** task frame instructs an RWA or unit to follow a circular route around a center point. You must specify this center point. By default RWA monitor their supplies to guard against running out of fuel or ammunition. If supplies are low, RWA automatically fly to their FARP point. When you assign this frame, you must specify a FARP point (a point or text).

The Orbit task frame has four editable RWA tasks: Orbit, Unit-FARP, Radar-Warn-Recvr (aka Radar Warning Receiver), and React-to-Contact (aka RWA Reactions). By default this frame's React-to-Contact task and Radar-Warn-Recvr task are set to allow reacting.

To view an Orbit task frame:

1. Select **New Scenario**.
2. Create an AH-64 helicopter.
3. Assign the AH-64 an **Orbit** frame. The Orbit task editor appears in the Editor area.
4. Click on the orbit location (a point or text control measure is acceptable) if already created. Otherwise, click in the Map to create one. Edit the other task parameters (optional).
5. Click **Done** in the Orbit task editor. The Unit-FARP task editor appears in the Editor Area.
6. Click on the FARP (resupply) location (a point or text control measure is acceptable) if already created. Otherwise, click in the Map to create one. Edit the other task parameters (optional).
7. Click **Done** in the Unit-FARP task editor.
8. Select On-Order to start the mission. The AH-64 should circle the specified point.

B.5.5 RWA Assemble Frame

The **RWA Assemble** task frame instructs an RWA or unit to halt in a coil formation. You must specify a center point. If the vehicles are currently on the ground, they move to assume the coil formation on the ground.

During an Assemble frame, vehicles in an RWA pair fly to locations directly opposite each other, on either side of the center point, and land. If a unit containing more than two vehicles is told to Assemble, the vehicles spread out evenly around the center point at the specified radius.

This frame has three editable RWA tasks: Assemble, Radar Warn Receiver, and React-to-Contact (aka RWA Reactions). By default this frame's React-to-Contact task is set to allow reacting; while its Radar-Warn-Recvr task is set to disable reacting.

To view an Orbit task frame:

1. Select **New Scenario**.
2. Create an AH-64 flight-of-5.
3. Assign the AH-64 unit an **Assemble** frame. The Assemble task editor appears in the Editor area.
4. Click on the center point (a point or text control measure is acceptable) if already created. Otherwise, click in the Map to create one. Edit the other task parameters (optional).
5. Click **Done** in the Assemble task editor.
6. Select On-Order to start the mission. The AH-64 unit should fly to the positions around the center point.

B.5.6 RWA Attack Frame

The **Attack** task frame can be assigned to an RWA or unit. When you assign this task, you must specify an attack objective.

There are two types of attack: Hover (PopUp) Attack and Running Fire Attack. The default type is Hover Attack.

When instructed to perform a Hover Attack, the Fly-Route task enables the unit to move to the area of the objective. Once there, an Occupy-Position task creates a battle position in the shape of a "V". The RWA fly to the positions; the unit then executes an RWA PopUp task that cycles through the subordinates assigning them a vehicle-level PopUP task. This results in only one RWA popping up at one time. The unit continues with the popup attacks until it receives a new order. See Section E.4 [RWA Attacks], page 228.

When instructed to perform a Running Fire Attack, the Running-Fire task causes rotary wing aircraft to fly toward the user-specified attack objective, searching for targets. Once targets are spotted, the vehicles dive toward the attack objective while firing at enemy vehicles.

Each vehicle turns and flies toward the start point (point from which it began) if one or more of the following three conditions occur:

- The vehicle gets too close to the attack objective.
- The vehicle destroys its intended target.
- The vehicle runs out of ammunition.

Once the vehicle reaches its starting point, it attacks again if:

- It is not out of ammunition.
- Targets still exist near the attack objective.

Note: If you select Running Fire attack, the RWA attack does not need to be followed by an On Order frame. See Section E.4 [RWA Attacks], page 228.

B.5.7 RWA Hasty Occupy Position Frame

The `RWA Hasty Occupy Position` task frame is analogous to the Hasty Occupy Position frame for ground vehicles. This task frame finds covered and/or concealed positions along the battle position and instructs the subordinates to move toward these positions.

Based on the battle position and the number of subordinates, ModSAF calculates both the number of vehicles per segment (the battle position consists of one or more line segments) and the battle areas (areas where each vehicle searches for cover). The subordinates are assigned positions from one end of the battle position to the other in an order that ensures that no vehicle crossover occurs while they are traveling to their positions. The RWA either land (the specified "Altitude at End" is 0.0) or hover at the battle position locations.

While at the battle position, the RWA run the React-to-Contact task to monitor the battlefield for enemy vehicles. If enemy vehicles are spotted, the RWA unit performs a Hover (PopUp) attack (by default) until all enemy are destroyed. The RWA React-to-Contact task then stops the attack and returns to monitoring for enemy.

Note: Similar to the Actions-on-Contact task for the ground vehicles, this task is overridden by the `Stop Reaction` button.

By default the Radar-Warn-Recvr task is set to disable reaction.

B.5.8 RWA Bounding Overwatch Frame

The **RWA Bounding Overwatch** task frame is analogous to the Overwatch Movement frame for ground vehicles. It divides an RWA unit into two functional groups: one group is moving along the route, the other group is executing an Occupy-Position task and watching for enemy vehicles.

When you give the On Order to execute a Bounding Overwatch, the RWA unit splits into two functional groups with the larger group in support position (occupying a position). Once that group is done occupying a position, the second group flies to the next overwatch position. While the traveling group is moving toward the overwatch position, the support group individually pops-up while in its position. The RWA hover at the end of the route.

RWA monitor their supplies to guard against running out of fuel or ammunition. If supplies are low, RWA automatically fly to their FARP point. When you assign this frame, you must specify a route (a point, line, or text control measure) and a FARP point (a point or text).

This task frame has four editable RWA tasks: Bounding-OW (aka RWA-Bounding-Overwatch), Radar-Warn-Recvr, Unit-FARP, and React-to-Contact (aka RWA Reactions).

The React-to-Contact task monitors the battlefield for enemy. If a target is found that satisfies the unit's rules of engagements, the unit automatically attacks if reactions are enabled.

To view the RWA Bounding Overwatch (OW) Frame:

1. Create an AH-64 flight-of-5.
2. Use the execution matrix to assign the unit a Bounding OW frame to a point about 5 or 6 km away.
3. Issue the On Order.

B.5.9 RWA Laser Designation Frame

The **RWA Laser Designation** frame lets a remote vehicle designate for another vehicle. You can assign this frame to the OH-58D/AH-64 Pair, a special unit consisting of one OH58D (the designator) and one AH64 (the shooter).

To view RWA Laser Designation, do the following steps:

1. Find a place on the database where there is a ridge or a hill. (You can display contour lines.)
2. Place a T80 platoon on one side of the hill/ridge. Give it "Hold" fire permission with the ROE editor.
3. Create a OH-58D/AH-64 on the other side of the hill/ridge about 1 - 2 km away from the T80 platoon. The T80s and RWA should not be able to see each other. (Use the Terrain Tool button to verify lack of visibility).
4. Set the toggle, under Map Notations on the PVD Controls editor, to display altitude on the Map.
5. Set the toggle, under Altitudes on Map on the User Preferences editor, to display altitude AGL.
6. Show the Message Log.
7. Assign the RWA unit a RWA Laser Designation frame. Give the shooter and designator points right in front of them and position the suspected enemy location near the enemy position.
8. Issue the On Order. You should see the following:
    1. The two RWA vehicles move toward their correct locations. Upon arrival, the Message Log displays a message indicating that the designator has secured the position.
    2. The designator starts to popup. It continues to popup until it sees the T80s. It then remains at that altitude.
    3. The designator sends a radio message saying that it is "Designating a target at .....". You should see this on the Message Log.
    4. After a short delay, the shooter receives the radio message and changes direction to head toward the passed location and shoot at the location passed in the radio message.

       NOTE: The shooter probably won't be able to see the target when it shoots. It is shooting at a location.
    5. The designator stays up for a certain amount of time, and then comes back down. Once the designator is down, it waits for a while and then starts increasing altitude again. Note: This lase and shoot process continues until all the enemy are dead or the designator gets shot at. Note: If the designator receives fire, the task ends allowing the OH58D to return fire.

B.5.10 RWA GND Laser Designation Frame

The **RWA GND Laser Designation** frame lets a remote ground vehicle designate for another vehicle. You can assign this frame to the AH-64/HUMMV Team, a special unit consisting of one HUMMV (the designator) and one AH64 (the shooter). You can also assign this frame to an AH-64/DI Team. The ground vehicle performs as a remote laser designator to enable the RWA to actually shoot a Hellfire missile.

You set up this frame (see the RWA Laser Designation frame above) by specifying a suspected enemy location and locations for the designator and the shooter to move to. NOTE: The designating location is important; if the designator cannot see the target, it terminates the laser designation task.

The library, **liburwagndldsg**, contains information for the unit level remote ground laser designation task that runs on units of one RWA and one ground vehicle.

Appendix C Tasks

This chapter describes tasks that you can modify while a unit is executing a task frame or a reaction.

Tasks contain operating parameters to control behavior. For example, movement behavior is dictated by parameters such as destination, speed, and formation. Tasks also monitor the battlefield situation to determine reactive behavior. For example, the Actions-on-Contact task tests for the observance of enemy vehicles. When they are detected, a reaction (such as assaulting) can execute to handle the situation.

C.1 Travel Task

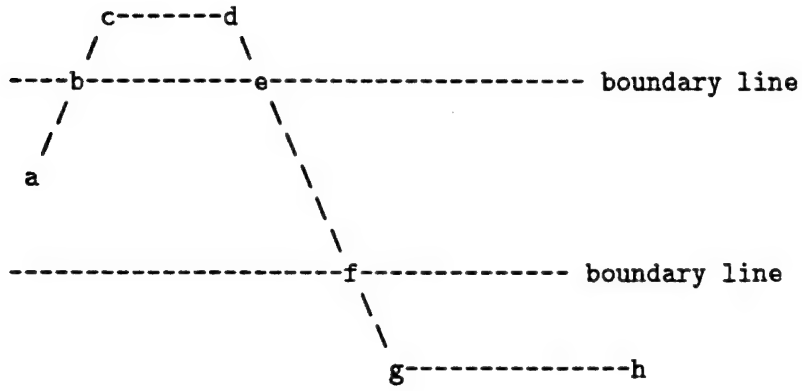
You must supply either a route or a destination point. The route is a line graphic and the destination point is either a point or text graphic. For a route, the vehicle will head for the closest segment of the route that it has not passed.

Movements goals are determined by the setting of the travel type parameter. The travel type can be either:

- Cross Country - The goal is generally to reach given waypoint(s) and stay in formation.
- Roadmarch - The goal can also be expressed as a desire to reach a series of waypoints. However, road following has the added constraint of keeping vehicles on the road in the correct order. The selection of a speed is a function of both the need to remain on the road at corners and the need to maintain separation,

The physical capabilities of a vehicle (maximum turn rates, maximum acceleration and deceleration rates, maximum speed, minimum turn radius) are considered for both travel types. To improve a ground unit's ability to stay in formation when traveling a cross-country route, create the route so that its vertices are no further apart than 500-1000m and try to avoid having sharply acute angles (less than 30 degrees). Having a unit go to a point that is too far away (for example 10km), impairs the unit's ability to stay in formation.

You can optionally specify left and right boundary lines to constrict a unit's route. In the following figure assume your route had vertices: a-c-d-g-h. If you specified the boundary lines shown in the figure, than the route would be clipped to include the vertices: a-b-e-f.



In addition to setting destination, travel type and boundaries, you can set the following task parameters:

- Formation - select a formation from an offered list.
- Rate of March - set the desired speed for vehicles.
- Catch-up Speed - specify a catch-up speed limit for a vehicle that has fallen behind. A value of zero means that there is no limit.
- Dismounted Speed - set the desired speed for Dismounted Infantry.
- Following Leader/Offset - specify these parameters for the Follow a Vehicle frame:

  Angle Offset - angle that a following unit attempts to maintain relative to a leading vehicle.

  Offset Distance - distance that a following unit attempts to maintain relative to a leading vehicle.

  Following Leader - the vehicle that a unit is to follow.
- Spacing - choose Closed (50 meter), Open (100 meter), or User Specified spacing. When you choose "User Specified" spacing, set an additional parameter (User Specified Spacing,) to indicate the spacing between vehicles. For a platoon executing a "Move-type" frame, you can dynamically modify the movement task parameters by selecting "open", "closed" or arbitrary values of "user specified". When dynamically changing the spacing, depending on the magnitude of the change, the vehicles can make unusual turns as the vehicles rush to get into their new spacing.
- IFV Offset - specify offsets for use in Mixed Platoon movement (where an Infantry Fighting vehicle (IFV) and its associated DI move in a coordinated pattern).

  Offset (x) - a left side/right side offset. A negative value means follow while maintaining a position left of the vehicle.

  Offset (y) - a forward/behind offset. A negative value means follow but remain in front of the vehicle. For example, the -0.15 KM default tells a following DI to stay 150 meters in front of its associated IFV.

See the libutraveling library for additional task information.

C.2 March Task

The March task implements the ability for companies to perform movement. Basically, it accepts the same parameters as the unit Travel task. However, in addition to being able to set the Formation parameter, you can assign a subformation to indicate a formation for the individual platoons. You can also set Subspacing to indicate the distance between vehicles in each platoon as well as Spacing to indicate the distance between the platoons in the company. The supported movement parameters such as: route, speed, and formation are described in the Travel task.

You must supply either a route or a destination point. The route is a line graphic and the destination point is either a point or text graphic. For a route, the vehicle will head for the closest segment of the route that it has not passed.

See the libucmarch library for additional task information.

C.3 Overwatch-Move Task

The Overwatch-Move task lets a unit (currently only a platoon or smaller) move to a destination point or along a route in an overwatch fashion. Overwatching divides the unit into two "functional" groups, and only one group moves at a time. Whenever a group is traveling along the route, the other group is occupying a position (by executing a Prep-Occupy-Position task) and watching for enemy vehicles. This method of travel is usually used during reconnaissance missions.

The Overwatch-Move task accepts most of the same parameters as the unit Travel task plus two additional parameters:

- Movement - specifies either "bounding overwatch", "non-bounding overwatch" or "non-overwatch (regular) movement". In bounding overwatch, the functional groups essentially leapfrog each other along the route. In non-bounding overwatch, the same functional group always travels into new territory first, and then the following group catches up along side.
- Use Concealed Routes - specifies whether the bounding section should attempt to use trees, canopies, and buildings to gain concealment from the enemy.

Platoons containing three vehicles are treated specially in bounding overwatch. ModSAF implements what is called "traveling in force," where one vehicle changes which group it belongs to in order to always belong to the group that is traveling forward. In this way, two vehicles always travel towards the next objective, while one vehicle supports them.

The Overwatch-Move task automatically ends when the unit reaches the objective or when the unit is no longer capable of performing the overwatch movement (for example, when the number of vehicles capable of movement falls below two).

See the libumxowm and the libuoverwatchmove libraries for additional task information.

C.4 Traveling-Overwatch Task

The Traveling-Overwatch task creates two groups: the traveling group which contains a single vehicle (the unit leader, the vehicle responsible for running that unit's tasks) and the support group (all the other unit vehicles). The traveling group drives down a user-specified route at a user-specified distance (typically 500 meters) in front of the support group.

While waiting for the traveling group to get out in front, the support group executes a Prep-Occupy-Position task which moves it to a position from which it can see the overwatch position. The overwatch position for the Prep-Occupy-Position task is approximately the spot where the traveling group will be when the support group begins its travel.

The support group waits there until the traveling group reaches the specified distance from the support group. Then it travels to join the unit leader.

During a reaction, the groups disappear, and the unit establishes itself in its original formation. After the reaction, the task restarts.

The Traveling-Overwatch task accepts most of the same parameters as the unit Travel task. The supported movement parameters such as route, speed, catch-up speed, formation, and formation-spacing are described above in the Travel task. One additional parameter is "Support Group Following Distance" which specifies the distance (typically 500 meters) the support group maintains behind the Traveling group.

The Traveling-Overwatch task automatically ends when the unit reaches its destination (such as the end of its route) or when the unit is no longer capable of performing the task (for example, when the number of vehicles capable of movement falls below two).

See the libutravelow library for additional task information.

C.5 Occupy-Position Task

When this task results from assignment rather than reaction, you must supply a Battle Position line, and an Engagement Area TRP (target reference point, line, or area) to the Occupy-Position Task. If an invalid Battle Position (one without at least two distinct end points) is entered, ModSAF displays a radio message and ends the Occupy-Position task. Sometimes the task requires you to specified a Left TRP and a Right TRP.

When occupying a position, a vehicle is assigned an Engagement Area TRP that is the center of mass of its most threating enemy cluster. As A vehicle's Engagement Area TRP moves as it becomes aware of enemy movement.

When performing an occupy position, vehicles, instead of shooting from one position, can move after detecting accurate hostile fire. This happens when the task is set to use alternate fire positions (the default setting).

A vehicle using alternate fire positions can move between the primary firing position, the alternate firing position, and the hidden position (when an alternate and a hidden position are found). The primary and alternate firing positions are hull-defilade positions, and the hidden position is a turret defilade position. ModSAF terrain reasoning software computes and creates these positions as point objects.

Vehicles first move to the primary firing position. Then, if the vehicle detects that it is receiving accurate fire, it backs up to its hidden position. Next, if there is an alternate firing position, the vehicle will immediately move forward to it. If there is no alternate firing position, the vehicle will wait a random amount of time at the hidden position and return to the primary firing position.

If the vehicle receives accurate fire while at the alternate firing position, it moves to the primary firing position in the same manner as it moved to the alternate firing position. These evasive actions avoid having the vehicle stay in one place if it is receiving accurate fire.

If the vehicles are in a wide-open plain and no primary firing positions can be found, then using alternate firing positions does no good. In this case, the vehicles will occupy their default positions on the battle position and will not change fire positions unless the enemy moves.

See the libupoccpos and libuoccpos libraries for additional task information.

C.6 Assembly-Area Task

This task, used by the company-level Assembly Area frame, needs a location to assemble around. The default radius of the assembly area is 700 meters, however you can change that setting.

See the libucpoccaa library for additional task information.

C.7 Change-Formation Task

The Change-Formation task uses a point where the unit is supposed to assemble, a direction the unit is to face, and a unit's new formation. The order of vehicles during movement is specified by the position numbers of the vehicles in the unit. (See libformationdb for details.) There is no "intelligent" algorithm for the ordering of the vehicles, i.e. front vehicles move first and then the rear vehicles. This is because the ordering depends on other factors such as terrain and environment. Typically, the order of vehicle movement is at the platoon leader's discretion.

The Change-Formation task is available on the platoon level and on the mixed unit level. A mixed unit is a unit with DI and vehicles in it. Examples of mixed units are a M2/DIGroup Platoon. When a Change-Formation is issued to a mixed unit whose DI are dismounted, two unit level Change-Formation tasks are spawned:, one for the DI unit and the other for the vehicle unit.

See the libuchformation library for additional task information.

C.8 Assault Task

The Assault task can execute as a result of user assignment or an Actions-on-Contact reaction. When it results from assignment of the Assault task frame, you must supply an objective. This objective can be a line, area, point, or text.

When the reaction selected by the Actions On Contact task is an Assault, then the vehicles use a location in front of the enemy as the objective.

When 50% of the vehicles in the assaulting unit are destroyed, the Assault task causes the platoon to prematurely occupy a position. Note that when you select Assault for the Action Drill reaction choice and 1 for the Danger Threshold, the Actions-on-Contact task does not stop the

assault until all of the enemy vehicles are dead. In that case, if one of the enemy vehicles is still alive, the assault reaction continues until you select STOP REACTION.

You can set the following Assault task parameters:

- Route - an optional route to the objective.
- Speed - the rate of movement to the objective.
- Stopping Assault Criteria - a percentage of unit strength below which the unit stops attacking. The number of vehicles representing 100 percent unit strength is the number in the unit when the attack starts.
- Secure Objective - a toggle which tells the unit whether to remain occupying a position after the assault or to automatically advance to the next phase of the mission. By default, the unit remains occupying a battle position rather than automatically advancing to the next mission phase.
- Formation - one formation selected from a list.
- Spacing - Closed (50 meter), Open (100 meter), or User Specified spacing is available. When you choose "User Specified", you can set an additional parameter (User Specified Spacing) to indicate the spacing between vehicles. You can alter this parameter for a platoon executing a "Move-type" frame, to dynamically modify its movement task. Vehicles, when dynamically changing their spacing, can make unusual turns (depending on the magnitude of the change) as they rush to get into their new spacing.

See the libuassault library for additional task information.

C.9 Attack Task

The Attack task is used by the company-level Attack frame. It requires an objective and can take an optional route. If you do not supply a route, ModSAF generates a route to link the current position to the attack objective.

The Attack task directs the company subordinates to follow the route to the objective using the Travel task. The unit can fire at the enemy while traveling toward the objective.

Once the unit reaches the objective or the starting unit strength drops below a certain percentage, the unit does an Occupy-Position on a generated battle position. The location of this battle position is based on the direction from the original position to the attack objective. ModSAF

attempts to place the unit in defensible positions with its back to the original position and its front to the enemy. Once these positions are secured, the vehicles stay in the occupy position state until directed otherwise.

The Attack task editor contains a "Secure Objective" toggle which tells the unit whether to remain occupying a position after the assault or to automatically advance to the next phase of the mission. By default, the unit remains occupying a battle position rather than automatically advancing to the next mission phase.

See the libucattack library for additional task information.

C.10 Actions-on-Contact Task

The Actions-on-Contact task monitors ground enemy activity. When vehicles in the unit detect enemy, the task examines its parameters to determine whether to trigger an Action Drill or Contact Drill reaction. In a Contact Drill, the unit continues its current mission but has its fire permission set to "Free". In an Action Drill, the unit performs the action you specify.

The Actions-on-Contact task editor displays parameters that are set with defaults which you can alter. In addition to an Action Drill Reaction parameter, this editor contains:

- An Enable/Disable toggle to let you specify whether the reaction to ground enemy activity should fire or be ignored.
- A Threat List which shows the vehicle class categories for ground threats. All threats above the one pointed to by the "Contact Drill" separator are classified as "Action Drill" or "high-danger" threats. All threats in the list below "Contact Drill" are classified as "low-danger" threats. You can drag a class to another place (toward the top to make it high-threat or toward the bottom to make it low-threat).
- A Dangerous Threat Threshold which specifies the number of high-threat enemy that must be encountered for an Action Drill reaction to trigger. If there are fewer than this number of high-threat enemy, and there are some threats to react to, then the Contact Drill reaction triggers. The Dangerous Threat Threshold has a default setting of one. This means that the unit executing the Actions-on-Contact task classifies the detection of one or more high-threat enemy as a situation that requires an Action Drill.

During an Action Drill, the unit performs the action specified in the Action Drill Reaction parameter. The reactions that you can select for an Action Drill include:

- Attack by Fire - Interrupt current mission to perform an Occupy Position with fire permission set to "Free". ModSAF creates a battle position facing the enemy and chooses logical target reference points (TRPs) with the engagement area TRP at the enemy location. The vehicles in the unit position themselves in a defensive (covered, if possible) position along the generated battle position.
- Withdraw - Interrupt current mission to retreat. ModSAF creates a withdraw point far from the enemy and in the opposite direction. Vehicles in the unit fire smoke grenades before withdrawing if they are available.
- Assault - Interrupt current mission to attack the enemy. ModSAF creates an assault objective a specified distance before the known enemy center of mass and causes the vehicles to move there. This distance is parametric data, located in the configuration files. After reaching the assault objective, a reacting platoon does an occupy position in front of the enemy. During the Assault, the unit's fire permission is set to "Free".
- Contact Drill - Vehicles continue following the current mission but with "Free" fire permission. To change the fire permission, use the Rules of Engagement button (second red button on the right).
- No Action - Vehicles continue following the current mission without any change to their fire permission. The task goes back to monitoring for enemy contact. To change the fire permission, use the Rules of Engagement button (second red button on the right).

Note: The Actions-on-Contact task editor for a company-sized unit is similar to the editor for a platoon-sized unit except that the Action Drill reaction choices are modified to include company tasks rather than platoon tasks. This means that "Attack" replaces "Assault".

The Actions-On-Contact task stops the Action Drill reaction if the number of high-threat enemy vehicles falls below the Dangerous Threat Threshold value that caused the reaction to execute.

The Actions-on-Contact task does not end until the task frame that it resides in is destroyed. However, this task does go back to the monitoring state when action is no longer required (for example, there are no detected enemy). The Actions-on-Contact task remains active to sponsor the reaction it generates even if the original frame (of which it was a part) is suspended. In this way, the reaction can be monitored and stopped when necessary. Also, if the situation changes (not enough high-threat enemy left) to warrant an Action Drill reaction, the Actions-on-Contact task stops the current reaction and starts the Contact Drill.

Example: Consider an Actions-on-Contact task set with a threshold of three vehicles, low danger reaction is Contact Drill, and high danger Action Drill reaction is Attack by Fire. Suppose that when the enemy is first detected only two high-threat vehicles are seen. A Contact Drill reaction executes. The unit continues to execute a Contact Drill until the number of enemy vehicles reaches three or more. At that time, the Contact Drill reaction stops and the Actions-on-Contact task returns to monitoring for enemy. It determines that the situation is high danger and immediately sponsors an Attack by Fire reaction.

The unit continues to execute the Attack by Fire until the number of enemy vehicles is less than the threshold value. It then stops the Attack by Fire reaction. When the Actions-on-Contact task returns to monitoring for enemy, it immediately sponsors a Contact Drill reaction.

You can change a reaction by selecting **CHANGE REACTION** from the user interface while the reaction is executing.

You can stop a reaction by selecting **STOP REACTION** from the user interface while the reaction is executing. This stops the reaction and continues the mission. Also, the Actions-on-Contact task will not respond to enemy activity until a new situation (more or fewer vehicles causing a transition to a different range) occurs.

See the libuactcontact and the libucactcontact libraries for additional task information.

C.11 React-Air Task

The React-Air task monitors enemy aircraft activity and triggers reactive events when a unit detects enemy aircraft or receives fire from them. A ground unit scatters when it sees or receives an impact packet from aircraft *unless* it is in a defensive (battle) position. You can set the task's **Active** parameter to specify whether or not the scatter reaction should occur.

The React-Air task does not stop until the task frame that it resides in is destroyed. This means that the React-Air task remains active even when the original frame is suspended so that the reaction can be easily monitored and stopped when necessary.

A unit is considered "not under fire" if no one in the unit has been fired upon for a given time. This time is parametric data with a typical value of 10 seconds. The reaction to enemy aircraft terminates after waiting the given time after the last air vehicle is spotted. This wait time is also parametric date with a typical value of 10 seconds.

During a scatter reaction, parametric data (spread_spacing) specifies the distance between ground vehicles. The typical value is 100 meters. The scatter speed, also parametric data, is set with a high speed.

See the libureactair library for additional task information.

To view the React-Air reaction:

1. Create an M1 platoon.
2. Task the platoon to move along a route.
3. Assign an air vehicle (Mig-27) an Ingress frame to fly over the route in an area that is visible to the platoon. Note that the platoon scatters as soon as the leader sees the aircraft. Once the aircraft is gone, the platoon returns to its original formation on the original route.

C.12 Company-React-Air Task

The Company-React-Air task implements a company-level reaction to air vehicles. When encountering air vehicles, the platoons scatter in different directions (if the vehicles are not in a defensive (battle) position). You can set the task's **active** parameter to specify whether the reaction should fire.

See the libucreactair library for additional task information.

To view the Company-React-Air reaction:

1. Create a M2 company.
2. Assign the company a March frame along a route.
3. Assign air vehicle (Mig-27) an Ingress frame to fly over the route in an area that is visible. Note that the company scatters as soon as the leader sees the aircraft. Once the aircraft is gone, the company returns to its original formation on the original route.

C.13 React-to-Indirect-Fire Task

The React-to-Indirect-Fire tasks monitors the battlefield. It lets a moving ground unit (platoon or smaller) respond to indirect fire (such as an artillery burst) in the immediate area (within 50

meters of a vehicle in a platoon) by accelerating when it receives an artillery impact packet. After a certain time of receiving no indirect fire, the unit slows to its original pace.

In addition, the unit monitors minefield explosions and executes the appropriate reaction if a mine is hit. The mine reaction choices are:

- Minefield Withdraw - Vehicles backtrack for a given distance and then the unit performs a Withdraw.
- Breach - The unit is divided into two functional groups. The first group performs an occupy position while the second group travels through the area. When the travel group stops, they occupy position. Then the previous occupy group moves along the same route. Mines explode, if encountered. The vehicles move slowly (around seven KPH) in a close, staggered-column formation along a given route. DI (if present) mount their companion vehicles before passing through the minefield.

You can set the following React-to-Indirect-Fire task parameters:

- Active - enable or disable a reaction to indirect fire.
- Mine Reaction - choose withdraw, breach, or not react.

See the libureactif library for additional task information.

C.14 Withdraw Task

Withdraw moves a unit away from the enemy, and then has it occupy position. Armored vehicles go to the withdraw point in reverse gear if the enemy is seen, otherwise they drive in normal forward gear. When the spotted enemy is no longer visible, an armored vehicle finishes its movement to the withdraw location in forward gear. (Once it transitions from reverse to forward, it remains in forward even if the enemy reappears.) Unarmored vehicles also travel to the withdraw point, but they always use forward gear. Vehicles in a unit are not required to keep formation.

While withdrawing, vehicles can use suppression fire which means that a vehicle remembers where an enemy was for thirty seconds after the enemy disappears. If the disappearing target was moving, a new position is calculated by using their current location and velocity.

You can supply either a route or a destination point. The route is a line graphic and the destination point is either a point or text graphic. If a line is specified in place of a withdraw point, ModSAF uses the line as a battle position and calculates a withdraw point.

In addition to setting a destination, you can set the following task parameters:

- Smoke - Enable or disable the release of smoke grenades. When enabled, a vehicle (such as an M1) launches smoke grenades if they are available. However, these smoke grenades are currently modeled as duds, which means that they explode but do not generate smoke clouds.
- Speed - Set to the desired speed.
- Speed Limit - Set to the catch-up speed limit. (A value of zero means that there is no limit.)

See the libuwithdraw library for additional task information.

C.15 Concealment Task

The Concealment task uses a route and a distance. If no enemy are present, the vehicles move the specified distance (which may be negative) along the route (with no formation) and then try to find concealment in that vicinity.

If enemy are detected, the vehicles ignore the input route and move the specified distance toward (if positive) or away from (if negative) the enemy before finding concealment. When enemy are detected, armored vehicles move with their frontal armor facing the enemy center of mass.

In addition to the route and distance, you can specify a speed at which the vehicles should travel. You can also configure the bounds within which a unit searches for positions using the front_width, forward_spread, and backward_spread parameters.

This task ends when the subordinate vehicles reach the desired positions.

See the libumxconceal library for additional task information.

C.16 Delay Task

The Delay task enables a unit (currently only platoons) to perform the delay maneuver. The unit is divided into two functional groups who perform withdraws (when the enemy is close) to user-specified battle positions in a nonbounding fashion. One functional group withdraws to the first battle position while the second functional group remains and fires at the enemy. When the first functional group completes the withdraw, the second functional group begins to withdraw to the same battle position occupied by the first group. Once the second group is finished occupying the battle position, the first group withdraws to the next battle position, and so on.

This task requires at least one battle position, with an option of accepting up to four. The Delay task automatically ends when the unit reaches the last battle position.

The following parametric data is configurable for the Delay task in the ModSAF parameter files:

- enemy_distance - This distance indicates how close the center of mass of the enemy vehicles must be to the platoon leader of the delaying unit, if the unit is to withdraw to the next battle position.

See the libudelay library for additional task information.

C.17 MLRS Task

The Multiple Launch Rocket System (MLRS) task implements the movement characteristics of an MLRS unit performing an indirect fire mission.

See the libumlrs and libvmlrs libraries for additional task information.

C.18 Tow Task

The Tow task implements vehicle towing. The recovery vehicle moves to a disabled vehicle and then tows it to a user-specified towing destination.

See the libutow and libvtow libraries for additional task information.

C.19 Repair Task

The Repair task negotiates repairs with a disabled vehicle. The task can be assigned to the German M113 SKORPION vehicle. Repairs are negotiated using **cgs** library functions. Currently, partial repair of damage is ignored, a repair is either complete or incomplete.

Note: You must specify the disabled vehicle, a towing vehicle (a US M88A1), and the the Unit Maintenance Collection Point (UMCP), the location to tow when on-site repair can not be accomplished.

See the liburepair, libvrepair and libvreceiverepair libraries for additional task information.

C.20 Supply Task

The Supply task implements ground vehicle resupply. The supply vehicle iteratively moves from one vehicle to the next within a circular area and resupplies the individual vehicles.

Note: You must specify the center and radius of the circular resupply area.

See the libusupply and libvsupply libraries for additional task information.

C.21 Unit-Supply-RWA Task

The Unit-Supply-RWA task implements RWA resupply by a FARP (Forward Arming and Resupply Point) unit. The vehicles in the FARP unit (named M978/979 FARP) consist of an M978 fuel truck and an M979 ammunition truck.

The vehicles in the FARP unit iteratively move from one RWA to the next within a circular resupply area and resupply the individual vehicles on a "first come first serve" basis.

For resupply to occur, the vehicles in the FARP unit and the RWA must belong to the same side. The resupply time is parametric data (currently set to five minutes for fuel resupply and five minutes for ammunition).

After the resupply is completed, the resupply unit returns to its base.

Note: You must specify the center and radius of the circular resupply area.

See the libusupplyrwa library for additional task information.

C.22 Breach Task

The Breach task executes as a result of user assignment or a React-to-Indirect-Fire reaction. If this task results from the assignment of the Breach task frame, you must supply a route (line). When the minefield reaction selected for the React-to-Indirect-Fire task is a Breach, ModSAF generates a breach route out of the minefield.

When a vehicle is breaching a minefield it can create breach lane markers to mark its path and show others the safe route through the minefield. In addition to setting a route through the minefield, you can set task parameters to specify the maximum distance between markers and the breach lane width. Creation of these markers is optional; you are allowed to disable their creation.

See the libubreach library for additional task information.

C.23 Return-to-Base Task

You must supply a base location to the Return-to-Base task. You can set the speed and altitude or use the task's defaults.

See the liburtb library for additional task information.

C.24 Follow-Route Task

You must supply a route to the Follow-Route task. Aircraft fly toward the closest segment of the route that they have not passed. You can set the speed, altitude, movement type, and radar parameters or use the task's defaults.

The movement type values are:

- Low Level - Vehicles fly at a constant altitude, only increasing altitude to go over an obstacle.

- Contour - Vehicles follow the contour of the earth.
- Nap of Earth (NOE) - Vehicles maintain constant altitude AGL, veering around obstacles.

See the libuflwrte library for additional task information.

C.25 Commit-Criteria Task

While performing the Combat Air patrol (CAP) or Sweep task frame, an airplane automatically performs an air-to-air intercept if a target satisfies the requirements of the Commit-Criteria task.

The vehicle-level air-to-air intercept task controls the movement of a vehicle during an intercept. In its current implementation, it guides the aircraft on a pure-pursuit course of the enemy.

Commit-Criteria is a unit-level task that detects when a group (currently only one) of vehicles have detected a radar target that meets the commit criteria. It creates an intercept task frame and assigns it to the unit, causing the unit to perform an air-to-air intercept on the target.

The following threshold parameters must be met before the commit task is initiated:

'Commit-Target Range'

Specifies the maximum range threshold distance between vehicle and target that would trigger this task.

'Commit-Target Aspect'

Specifies the maximum target aspect angle (left or right) threshold that would cause this task to trigger.

'Commit-Target Speed'

Specifies the minimum speed threshold that the target must be flying to trigger this task.

The following Commit-Criteria parameters are used as inputs to the air to air intercept task.

'Intercept-Weapons Enabled'

Specifies a list of the weapons that an aircraft is allowed to shoot during an air-to-air intercept task. The choices are Long-Range Missile, Medium-Range Missile, and Short-Range Missile.

'Intercept-Perform Crank'

Specifies whether to perform a crank maneuver after each shot during an intercept.

'Intercept-Disengage Method'

Specifies how the aircraft should disengage from a target during an intercept (if the target was not destroyed). The choices are S/W Controlled (software controlled), Merge, or Bugout.

'Intercept-Beam At Range'

Specifies the range in meters at which the aircraft should turn into the enemy target's radar beam.

See the libucommit library for additional task information.

C.26 Bingo-Fuel Task

The Bingo-Fuel task contains parameters that identify a speed, altitude, and refuel point. When an aircraft satisfies the test for bingo fuel, it leaves its route and flies to its refuel point where it lands to get refueled and rearmed.

See the libufwabingofuel and libvfwabingofuel libraries for additional task information.

C.27 Unit-FARP Task

The Unit-FARP task contains parameters that identify a speed, altitude, and FARP (resupply) point. There are also task parameters to enable or disable FARP reactions. There are two FARP reactions: one for fuel and one for ammunition.

An RWA monitors its fuel supply. If the fuel FARP reaction is enabled, an RWA with only enough fuel left to fly to the FARP point, leaves its route and flies to the FARP point. If lands at the FARP point and waits to be refueled.

An RWA monitors its ammunition supply. If the ammunition is depleted, an RWA leaves its route and flies to the FARP point. If lands at the FARP point and waits to be rearmed.

See the liburwafarp and libvrwafarp libraries for additional task information.

C.28 CAP Task

You must supply a location for the Combat Air patrol (CAP) point. You can use the default values for movement parameters (including the racetrack distance, an inbound leg speed, an outbound leg speed, an altitude, and an orientation) or else you can supply values. ModSAF automatically generates the four segments of the racetrack orbit: an inbound leg, an outbound turn, an outbound leg, and an inbound turn. The orientation parameter specifies the direction of the inbound leg. The air vehicle makes a 180 degree counter-clockwise turn when transitioning between the inbound and outbound legs. The vector representing the outbound leg of the CAP is in the opposite direction of the inbound leg.

See the libucap library for additional task information.

C.29 FWA-Fly-Route Task

You must supply either a route or a destination point to the FWA-Fly-Route task. The route is a line graphic and the destination point is either a point or text graphic. For a route, the unit moves toward the closest segment of the route that it has not passed. Note: If there isn't enough distance between the vertices of an air route, the plane, due to its flight dynamics, will fly around rather than over a vertex. Also a plane can not make too sharp a turn.

In addition to setting a destination, you can set the following task parameters:

- Speed - set the desired speed for vehicles.
- Altitude - set the desired altitude for vehicles.
- Formation - select a formation from an offered list.
- Movement Type - choose Low Level, Contour, or Nap of Earth. See Section C.24 [Follow-Route Task], page 206.
- At End of Route Action - choose Orbit or Land to specify a route conclusion action.

See the libufwaflyrte library for additional task information.

C.30 Targets-of-Opportunity Task

The Targets-of-Opportunity task lets you determine whether FWA should ignore or engage targets of opportunity. You can use task defaults or set values for the following attack parameters:

- Maximum Distance Off Route - set the maximum distance the aircraft are permitted to fly off the route for an attack. Aircraft ignore distant targets located beyond this distance.
- Maximum Angle Off Route - set the maximum turn size permitted for route deviation. Aircraft ignore targets located in an area requiring a larger route deviation angle.
- Target of Opportunity Priorities - assign a unit's target priorities by type. To change priorities, drag a target type to a different position (towards the top to increase priority and towards the bottom to lower its priority) in the priority list. When you drag a type to the top of the list, you make it a first priority target. When you drag a type below "Do Not Target", that type is ignored as a target. Note: If attacks on targets of opportunity is enabled, spotted enemy FWA and RWA are always considered valid targets, even if the FWA and/or RWA entries are below the "Do Not Target" line. However, putting FWA and RWA lower on the list does give them a lower priority.
- Attack Speed - set the desired attack speed.
- Altitude - set the desired attack altitude.
- Attack Formation - select an attack formation from an offered list.
- Attack Geometry - select an attack geometry from an offered list.
- Attack Entry - select an entry type from an offered list.
- Attack Delivery - select a delivery type from an offered list.

See the libutgtoppty library for additional task information.

C.31 Close-Air-Support Task

While an aircraft is executing the Close-Air-Support task, CAS messages (generate with the Fire Support tool) to this aircraft cause the FWA to perform a ground attack upon enemy targets in the vicinity of the attack location.

Note: In order for FWA to receive the close air support request, the aircraft (such as an A10) must have an Artillery Radio (ArtyRadio component). The CAS messages generated with the Fire Support tool are propagated with the Artillery Radio.

You can choose whether FWA should ignore or engage CAS targets. You can use task defaults or you can set values for the following attacking parameters (target priorities, the attack speed, altitude, formation, geometry, entry and delivery). See Section C.30 [Targets-of-Opportunity Task], page 210.

See the libufwacas library for additional task information.

C.32 Attack-Ground-Target Task

The Attack-Ground-Target Task is a unit-level task that controls a FWA unit when it is performing a Ground Attack upon a specified target or a target of opportunity.

The states which comprise the task are:

'start' This state is entered when a unit-level FWA Ground Attack task is created to perform a ground attack on a specified target (location). When in this state, the task ensures that all aircraft in the unit have taken off. If any of the aircraft are on the ground, the task transitions to the **cant_attack** state to wait until all FWA in the unit are flying. If all of the FWA in the unit are air borne, the task verifies that there is sufficient distance between the FWA unit and the target location in order to perform the specified attack entry. If there is insufficient distance to perform the specified attack entry, the attack entry is modified to be Level and the attack delivery is modified to Laydown. The task then spawns a vehicle FWA Ground Attack task for the leader of the unit, as well as a vehicle FWA Formation Keeping and a vehicle FWA Ground Attack task for all FWA followers in the unit. The task transitions to the **attack** state to monitor the FWA Ground Attack.

'cant_attack'

This state is entered when any of the FWA in the unit are on the ground and cannot perform a unit ground attack. When in this state, the task continuously checks to ensure that all aircraft have taken off. Once the aircraft take off, the task verifies that there is sufficient distance between the FWA unit and the target location in order to perform the specified attack entry. If there is insufficient distance to perform the specified attack entry, the attack entry is modified to be Level and the attack delivery is modified to Laydown. The task then spawns a vehicle FWA Ground Attack task

for the leader of the unit and a vehicle FWA Formation Keeping and a vehicle FWA Ground Attack task for all FWA followers in the unit. The task transitions to the **attack** state to monitor the FWA Ground Attack.

'attack' This state is entered when the lead aircraft of the FWA unit has reached the attack ingress point (IP). When in this state, the task monitors the lead aircraft of the unit to determine when that aircraft begins its attack delivery. When the lead aircraft reaches the attack delivery, the task stops the vehicle FWA Formation Keeping task for all FWA followers in the unit and transitions to the **rendezvous** state to await completion of the ground attack.

'rendezvous'

This state is entered when the lead aircraft of the FWA unit has begun its attack delivery upon the specified target. When in this state, the task monitors the completion of the vehicle FWA Ground Attack task for each aircraft in the unit. Once all aircraft in the unit have completed the ground attack on the specified target, the task transitions to the END state to end the ground attack.

See the libufwagrndatk library for additional task information.

C.33 RWA-Fly-Route Task

The RWA-Fly-Route task requires either a route or a destination point. The route is a line graphic and the destination point is either a point or text graphic. For a route, the unit flies toward the closest segment of the route that it has not passed.

In addition to setting a destination, you can set the following task parameters:

- Speed - set the desired speed for vehicles.
- Altitude - set the desired altitude for vehicles.
- Formation - select a formation from an offered list.
- Movement Type - choose Low Level, Contour, or Nap of Earth. See Section C.24 [Follow-Route Task], page 206.
- Spacing - select Closed (50 meter), Open (100 meter), or User Specified. When you choose "User Specified", you can set an additional parameter (User Specified Spacing) to indicate the spacing between vehicles. For a platoon executing a "Move-type" frame, you can change this parameter to dynamically modify the movement task. Note: vehicles, when dynamically

changing their spacing, can make unusual turns, depending on the magnitude of the change, as they rush to get into their new spacing.

- User Defined Spacing - set a value for user defined spacing.
- Target Facing Mode - enable or disable this mode. When enabled, RWA fly toward their destination with their heading set to face the target.
- NOE TRP - a nap of earth target reference point. See Section 11.7 [Nap Of Earth Flying], page 107.

See the libuflyrte library for additional task information.

C.34 RWA-Bounding-Overwatch Task

The RWA-Bounding-Overwatch task divides an RWA unit into two functional groups. One group moves along the route; the other executes an RWA Occupy-Position task and watches for enemy vehicles. A task parameter, the "bound type" parameter, specifies whether the bounding is "successive" or "alternate". With successive bounding, the functional groups essentially "leapfrog" along the route. With alternate bounding, the same functional group travels into new territory first, and the following group catches up along side.

The RWA-Bounding-Overwatch task parameters are similar to those of the RWA-Fly-Route task. See Section C.33 [RWA-Fly-Route Task], page 212.

See the liburwabow library for additional task information.

C.35 Hover Task

The Hover task enables a group of RWA to hover in its current location at the specified altitude.

See the liburwahover library for additional task information.

C.36 Orbit Task

The Orbit task enables a group of RWAs to fly in a circle at a specified radius about a specified center point. They fly at the specified speed and altitude.

See the liburwaorbit library for additional task information.

C.37 RWA-Assemble Task

The RWA-Assemble task enables a group of RWA to assemble at a specified location.

See the liburwaassemble library for additional task information.

C.38 RWA-Attack Task

The RWA-Attack unit-level task enables RWA to attack an objective. There are two types of attack:

- Hover Attack - The RWA unit moves toward the objective. When the unit is near enough, it occupies a position facing the objective. (The RWA will not have passed the objective at this point.) When the unit has occupied position, the individual RWA start popping up for a certain time, shooting and then coming down. This behavior continues until the unit is given other orders.
- Running Fire Attack - The RWA-Attack task spawns a running fire task for the unit. This task spawns an independent running fire attack on each of the subordinates.

The two attack types are described in more detail in the following React-to-Contact Task section.

See the liburwaattack library for additional task information.

C.39 React-to-Contact Task

The React-to-Contact task implements a basic reaction for rotary wing aircraft (RWA). Once enemy vehicles are detected, the React-to-Contact task triggers an attack reaction. The default attack type is a hover (also called PopUp) attack.

There are two types of attack: Hover and Running Fire Attack. These attack types are described below. Note: If you select Running Fire attack, then the attack need not be followed by an On Order frame.

- Hover Attack - The RWA fly to the objective area. Once there, an occupy position is performed with the battle position in the shape of a "v". The RWA vehicles move to their battle positions and then a unit-level RWA PopUp task is started. This task creates a vehicle-level PopUp task on each of the unit subordinates. The unit-level task cycles through the subordinates and assigns the vehicle popups individually, resulting in only one RWA vehicle popping up at once. The unit continues with the Popup attack task until it receives another order.
- Running Fire Attack - The RWA-Attack task spawns a Running Fire Attack task on the unit to tell the vehicles to fly toward the attack objective, looking for targets. Once the vehicles spot targets, they dive toward the attack objective while firing at the enemy vehicles. Each vehicle turns around and flies toward the starting position if one or more of the following three conditions exists:
  - The vehicle gets too close to the attack objective
  - The vehicle kills its intended target
  - The vehicle runs out of ammunition.

  Once the vehicle reaches its starting point, it attacks again if it has ammunition and there are still targets near the attack objective.

See the liburwareactcont library for additional task information.

C.40 Radar-Warn-Receiver Task

The Radar-Warn-Receiver task implements a unit-level RWA reaction to radar illumination.

Once an RWA recognizes that it has been illuminated by enemy radar, this task triggers a defensive reaction. This reaction includes jinking away from the source of the radar followed by a dive to a lower altitude (around 10 meters AGL).

Illumination of the aircraft stops when it is no longer detected by radar. Shortly (around 25 seconds) after the illumination stops, the RWA unit stops the reaction and returns to its original mission.

You can cancel the reaction by selecting **STOP REACTION** from the user interface while the reaction is executing. This stops the reaction and continues the mission.

Note: A ground radar vehicle (such as GBS_FAAD) uses a radio message to notify an anti-aircraft vehicle (such as an M2-Stinger) when its radar detects enemy aircraft. In response to this message, an anti-aircraft vehicle adjusts its heading to face the enemy. You can view this message if the Message Log is displayed.

See the liburwarwr and libvrwr libraries for additional task information.

C.41 Laser-Designator Task

The Laser-Designator task (urwalaserdsg) implements a unit-level task for remote laser designation. It runs on a unit consisting of 2 RWA, making one of the two RWA a remote laser designator and the other a shooter. The task is set up to accept locations for the designator and the shooter to go to OR calculate good locations using terrain reasoning. Currently, the task forces the user to enter the two locations.

The task instructs the designator to find a cover position by assigning an occupy position at the specified location. The shooter is told to move to its specified location and face the suspected enemy location. Once both RWA are in position, the task assigns the designator a PopUp task and it assigns the appropriate shooting tasks to both RWA. Once the designator has popped up and come back down, the task tells the designator and shooter to restart the lase and shoot process. This task ends if the designator is attacked, or the designator sees no more enemy.

See the liburwalaserdsg and libvrwalaserdsg libraries for additional task information.

Appendix D Recovery Operations

This appendix describes error messages and provides ways to recover from irregular situations. Error messages print on the console from which the program was started and generate a pop-up window on the display. Some errors also display in the SAFstation Message (Radio) Log.

D.1 Error Messages

This section describes some error messages you may receive when operating ModSAF. It also includes resolutions to these errors.

D.1.1 Invalid File name

A file name is valid only when it contains alphanumeric characters, underscores, or hyphens. If you attempt to save a file with an invalid name, a **Save File** pop-up window appears displaying the following message:

```
File name contains illegal characters.  Please use alphanumeric
characters only.
```

To correct the situation, click the OK button. The pop-up window requesting a name for the disk file reappears. Click a name from the list to create a newer version of an existing file, or erase the invalid name and enter another.

D.1.2 File Not Found

If you attempt to load a file that has not been saved, a **File Manager** pop-up window appears displaying the following message:

```
Please select/enter a valid file name.  Please use alphanumeric
characters only.
```

To correct the situation, click the OK button. The pop-up window requesting a name for the disk file reappears. Click a name from the list to load an existing file or erase the invalid name and reenter a valid one.

D.1.3 Duplicate Overlay

If you attempt to load a scenario file that contains an overlay with the same name as an overlay that is currently in memory, a **System Error** pop-up window appears displaying the following message:

```
Error loading scenario <scenario pathname>:
Overlay in file conflicts with existing overlay
```

To correct the situation:

1. Click the OK button.
2. Use the Overlay editor to change the name of the existing overlay. See Section 10.4 [Edit an Overlay], page 99.

In addition, corrections can be made by clicking **New Scenario** to delete all objects (including overlays) running on the same PO database number as the SAFstation.

D.1.4 Illegal Password

If the system does not recognize the password you enter, a system error pop-up window displaying the following message appears:

```
Password not matched
```

To correct the situation, retype the password and click the OK button. Use the Cancel button to avoid entering a password.

D.1.5 Stealth Not Found

If you try to access the Stealth Control Editor but ModSAF cannot access a Stealth vehicle, a system error pop-up window displaying the following message appears:

```
Unable to find preferred stealth
```

If you do not need to use a Stealth, press the Cancel button. Otherwise, there are several ways to correct the situation:

1. Bring up a Stealth on the network, if necessary.
2. Click on the Stealth's large arrow icon on the Map.

   If there are several Stealths on the network, there may be several Stealth arrows on the Map. Each one is different color. Use the Info button to get a particular Stealth's site/host ID to determine the arrow you should use.

D.1.6 Situation Change

If a unit changes its action (such as a reaction occurring) while you are in the process of changing the unit's task parameters, a pop-up window and radio message display the following message:

```
Unit changed what it was doing, overrides might not apply.  To make
the change, exit the override editor and start over.
```

This message informs you that the change you made may not apply since the situation change has actuated a new set of tasks. To ensure the change, repeat the change procedure. Otherwise, ignore the message if the change was insignificant.

D.1.7 Road Route

If the distance between two road points is too great, a system error pop-up window displaying the following message appears:

```
Unable to find a road route between specified locations.  Please
```

```
select a closer end point, and extend from there.
```

To correct the situation, click the Map to select a road point that is closer. Click the OK button.

D.1.8 Load Scenario Onto Different Terrain

When you attempt to load a scenario file that was created on a different terrain database, a pop-up window displaying the following message appears:

```
This scenario file uses a different terrain database.
Do you wish to convert the scenario file to the terrain database in use?

[Convert and Load Scenario]  [Cancel Scenario Load]
```

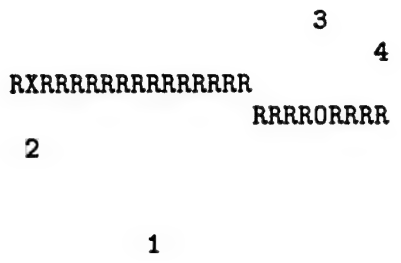
Click the **Convert and Load Scenario** button to convert the scenario to the local terrain database. If this is done, the PO converter is invoked to replan road routes (road segments are database specific).

If this is done, locations are converted by using the xy distance from the SW corner of the database and the PO converter is invoked to replan road routes (road segments are database specific).

Note: If there is a road near where the original road route was, then it will be used. Otherwise a straight-line route will be substituted. For example, if the roads are R and your route has these waypoints:

```
RR                RR3RRRR
  RR            RR      4
    RRRRRRRRRRRR
  RR            RR
R2
```

So that you go from 2 to 3 along the road, and you read this onto a different database which is like this:



you will go from 2 to X, then along the road from X to O, then from O to 3. If you load the scenario onto a database without roads in the area, the route would just go 1 to 2 to 3 to 4.

D.2 Recovering from a SAFstation System Failure

An indication that the SAFstation has had a system failure is that the normal SAFstation screen disappears, or that buttons or Map objects are no longer mouse sensitive. If necessary, ask a technician to close the SAFstation window and then restart the SAFstation. Simulated vehicles should reappear on the SAFstation screen.

D.3 Recovering from a SAFsim System Failure

When the SAFsim has failed, simulated objects disappear from the SAFstation screen.

If a SAFstation is working with more than one SAFsim (they all use the same PO database), then entities simulated on the failed SAFSim are automatically simulated on the other SAFsims. It takes at least 30 seconds for vehicles simulated on the failed SAFSim to transfer to the working SAFsims.

If a SAFstation is working with only one SAFsim, it is recommended that you periodically save the scenario on the SAFstation so that the exercise could be restarted.

Appendix E Exercises

Perform these exercises on the Fort Knox database. These exercises require a configuration of a single pocket ModSAF (GUI/SIM) running without the network (-nonet).

E.1 Mission Assignment

E.1.1 Assign a Basic Mission

1. Click on the Unit button (labeled with the blue tank icon) in the Button column. With the left mouse button, click on a location on the map to supply a location and then select an M1 vehicle as the Unit Type. Click the Done button in the Unit editor.
2. Using the Line button, draw a line of several cross country segments near the ground vehicle.
3. Point to the blue tank graphic on the map and wait for a black outline box to appear around it, then click the left mouse button to access the Unit Operations editor.
4. Click on the vehicle cell in the execution matrix in the Unit Operations editor. Click on "Select". Assign a Move frame selecting the line you created for the route. Click **Done** in the Travel task editor.
5. Give the On Order. The vehicle should start to move to the closest vertex that it has not passed.
6. Click **Speed** in "Map Notations" on the PVD Controls Editor to turn on the display of speed.
7. Point to the blue tank graphic on the map and wait for a black outline box to appear around it, then click the left mouse button to access the Unit Operations editor.
8. Click on the Move cell and select **Modify Task**. Select the Travel task.
9. When the Travel task editor appears, change **Rate of March** to 55 kph. Click **Done** in the Travel task editor. The vehicles should speed up to 55 kph.
10. Click **Speed** in "Map Notations" on the PVD Controls Editor to turn off the display of speed.

E.1.2 Assign a Road Route Mission from the Icon Strip

1. Using the Line button, draw a line of several road segments. Note: To permit selection of road segments, set "Use Roads" on in the Line editor.
2. Using the Unit button, create a platoon of friendly ground vehicles near the road start point.

3. Click the platoon icon (in the Icon Strip) and select **Other Operations** to access the Unit Operations editor.
4. Assign a Road March frame, and select the road route you created for the route. Click Done in the Travel task editor.
5. Give the On Order. The vehicles should follow the road to the end.
6. Click the Line button, and set the "Use Roads" parameter to off in the Line editor. Click **Abort** in the Line editor.

E.1.3 Assign Air Missions

1. Zoom out to a large area on the map. Using the Line button, draw a long line of several cross country segments.
2. Using the Unit button, create a friendly A10 FWA near the line.
3. Click the FWA vehicle to access the Unit Operations editor.
4. Assign an Ingress frame, selecting the line you just created for the route. When the Bingo Fuel editor appears, click on the map to create a refuel point, then click on the Done button.
5. Give the On Order. The FWA should move to the closest vertex that it has not passed, and travel to the end of the route.
6. Create a friendly F14D plane on the left edge of the map, facing East.
7. Click on the blue F14D. When the Unit Operations editor appears, click on the F14D cell in the execution matrix.
8. Click "Select" and then choose the CAP (Combat Air patrol) frame. The CAP task editor appears.
9. Click in the map to create a CAP point where the plane will patrol, then click on the Done button. When the Bingo Fuel editor appears, click in the map to create a refuel point, then click on the Done button.
10. Give the On Order. The F14D plane should take off and fly to the CAP point and then perform a racetrack orbit about the CAP point.
11. Click the Status Selections button in the Unit Operations editor. Click "Cap Detail" in the pulldown menu of tasks to view that task's status in the Unit Operations editor.

E.1.4 Alter a Mission with Immediate Interventions

Immediate interventions are temporary overrides that can change mission operation.

1. Create an A10 at one corner of the terrain database.
2. Click **Speed** in "Map Notations" on the PVD Controls Editor to turn on the display of speed.
3. Assign the A10 an Ingress task frame on a long, straight route at the default speed and altitude. Give the On Order.
4. After the A10 starts flying, issue a speed up Immediate Intervention. Verify that the A10 accelerates.
5. Issue a **Resume** Immediate Intervention. Verify that the A10 returns to its default speed.
6. Issue a slow down Immediate Intervention. Verify that the A10 slows down.
7. Under Map Notations on the PVD Controls editor, set the display toggles to show the altitude and stop the display of speed.
8. Under Altitudes on Map on the User Preferences editor, set the display unit to be **Preferred Units**.
9. Issue a fly higher Immediate Intervention. Verify that the A10 increases altitude.
10. Issue a fly lower Immediate Intervention. Verify that the A10 decreases altitude.
11. Issue an orbit Immediate Intervention. Verify that the A10 orbits at its current location.
12. Click **Altitude** in "Map Notations" on the PVD Controls Editor to turn off the display of altitude.

E.2 Platoon Frames

E.2.1 Hasty Occupy Position Frame

1. Select **New Scenario** from the File pulldown menu.
2. Create an M1 platoon.
3. Assign a Move mission to the M1 platoon and give the On Order.
4. Interrupt movement with a Hasty Occupy Position:
   - Click **Move** in the platoon cell and then select "Replace Temporarily" from the list of frame options. Click **Hasty Occupy Position** in the list of task frames.
   - An "Occupy Position" task editor appears. The Help line reads: "You must specify a Battle Position (Select a line on the map or create one using the Line Tool)".
   - Click on the Line button in the Button column. Repeatedly click on location(s) in the map to set the points of the battle position line. Click the Done button in the Line editor.
   - Click **Click Here for Map Input** in the "Engagement Area TRP" selection area of the Occupy Position task editor and then click in the map where you expect the enemy to be.

- Click the Done button in the Occupy Position task editor. The tanks will position themselves in the area designated by the Battle Position line.

E.2.2 Overwatch Move Frame

1. Select **New Scenario** from the File pulldown menu.
2. Create an M1 platoon.
3. Use the execution matrix to assign the platoon an Overwatch Move frame along a cross country route.
4. Give the On Order. The platoon will split into two functional groups: one that moves and one that occupies a position to overwatch the moving vehicles.
5. After one group of vehicles begins moving, assign the platoon a **Halt** using the "Replace Temporarily" option.
6. Restart the halted vehicles using the "Resume" option.

E.2.3 Assemble Frame

1. Select **New Scenario** from the File pulldown menu.
2. Create an M1 platoon.
3. Assign the platoon a Move frame along a cross country route using the execution matrix. Give the On Order.
4. After the vehicles begin moving, assign an Assemble frame with the "Replace Temporarily" option.
5. After the vehicles halt in a coil formation, restart their movement using the "Resume" option.

E.2.4 Pursue Frame

1. Select **New Scenario** from the File pulldown menu.
2. Create an M1 platoon.
3. Assign the M1 platoon a Move frame along a long route.
4. Create another M1 platoon.
5. Using the execution matrix, task the second platoon to pursue by selecting **Pursue** from the unit's list of available frames.

6. The movement task needs a unit to pursue for the Route input so the Travel task editor appears in the Editor Area. Either select a vehicle in the first platoon to pursue or use the "Show As Platoons" command (from the menu bar) and select the platoon icon. Give the On Orders. Notice that the second M1 platoon moves towards the first. The route updates occasionally to take into account the movement of the first platoon. The pursuing unit chases and then follows the first platoon. The pursuing unit doesn't end the Pursue frame and never outruns the first platoon.

E.3 Company Frames

E.3.1 Company Withdraw Frame

1. Select **New Scenario** from the File pulldown menu.
2. Create an M1 company.
3. Task the company by choosing "Withdraw" from the list of available frames. Click on the map to select a point to withdraw to.
4. Give the On Order. Vehicles that are not a part of a platoon will get functionally organized into a platoon and all three platoons will withdraw (one platoon at a time) at top speed to their final points (or intermediate points if the withdraw point is far away) and then occupy position.

E.3.2 The Assembly Area Frame

1. Select **New Scenario** from the File pulldown menu.
2. Create a T72M company.
3. Task the company to do the "Assembly Area" frame. Select an assembly point a short distance North of the company.
4. Give the On Order. Notice that the company will start breaking up and heading for the positions. Eventually, the platoons should form some sort of triangle which provides 360 degrees of coverage.

E.3.3 The Company Occupy Position Frame

1. Select **New Scenario** from the File pulldown menu.

2. Create an M1 company.
3. Use the line tool to create a battle position line for the company to occupy.
4. Task the M1 company to do a "Hasty Occupy Position" via the Execution Matrix in the Unit Operations editor. The CC and XO will each join a platoon and all three platoons will move toward the battle position without any vehicles crossing each other.
5. The M1 company will move to occupy position before the "On Order" is issued since the prep task for the frame tells it to do so rather than to halt. The prep task is what the unit does while waiting for the user to give the "On Order" authorization. If a user did not want the vehicles to move to position before an "On Order", he/she could assign a Halt frame followed by an On Order "Hasty Occupy Position".

E.4 Rotary Wing Aircraft (RWA) Attacks

E.4.1 Hover Attack

1. Select **New Scenario** from the File pulldown menu.
2. Click **Altitude** in "Map Notations" on the PVD Controls Editor to turn on the display of altitude. Select the use of "Preferred Units, AGL" from "Altitudes on Map" on the User Preferences Editor.
3. Create an AH-64 Flight-of-3.
4. Use the execution matrix to tell the flight to execute an Attack. Click in the map to set an objective location and set the type of attack to Hover Attack.
5. Place a platoon of T72 vehicles at the attack objective to give the AH-64s a target. Set the fire permission of the T72 platoon to Hold.
6. After the Attack on order is given, the RWA vehicles will move to near the objective in a rwa-line formation. Once they are near the objective, they will occupy a "v" position. Once the RWA vehicles are in positions, they will start to popup one at a time and shoot at the enemy. Notice they will continue to popup even if there are no live enemy there.

E.4.2 Running Fire Attack

1. Select **New Scenario** from the File pulldown menu.
2. Click **Speed** and **Altitude** in "Map Notations" on the PVD Controls Editor to turn on the display of speed and altitude.

3. Create a Mi24 Flight-of-2.
4. Use the execution matrix to tell the flight to execute an Attack frame. Click in the map to set an objective location and set the type of attack to Running Attack.
5. Place a platoon of M1 vehicles at the attack objective to give the M124s something to shoot at. Set the fire permission of the M1 platoon to Hold.
6. After the On Order is given, the RWA will move at search speed until they see the enemy. Once they see the enemy, they will dive and move at dive speed (which is slower). Notice they will continue diving toward the enemy until they kill an enemy vehicle, get too close to the attack objective, or run out of ammunition. Once one of these conditions is met, the RWA vehicle will break off and circle around for another pass. This continues until the enemy vehicles are all dead or the RWA is out of ammunition.
7. Click **Speed** and **Altitude** in "Map Notations" on the PVD Controls Editor to turn off the display of speed and altitude.

E.5 Conditional Phase Transitions

The conditional transitions (control measure, duration, and HHour) work for both air and ground vehicles, and with saving/loading scenarios. When you load a scenario that was created using various HHours, the HHours will be converted to the same offsets that they were in the original scenario. These transitions do not occur during reactions.

E.5.1 Set a Control Measure Transition

A control measure transition occurs when a unit detects that it is about to cross a control measure. A control measure can be a line, point, or text. Using a line rather than a point or text control does insure that the control measure is close enough to be considered crossed (50 meters for ground vehicles, 150 meters for rwa, and 500 meters for fwa).

Exercise 1: A Two-Phase Mission

1. Select **New Scenario** from the File pulldown menu.
2. Create a platoon and assign it a Move frame (On Order - by default),
3. Assign the platoon a Halt frame in the next (Phase 2) execution matrix column.
4. A 'Continue' button appears at the top and bottom of the execution matrix between the two task frame columns. Click this Continue button and select **Control Measure** from the menu.

5. Use the Line button to create a line between the platoon and the end move point so that the vehicles will cross this line before they reach the end move point. Click **Done** in the Line editor and in the Control Measure editor. The line has now been named as the control measure.
6. Select 'Move' from the On Order pulldowm menu.
7. The platoon should move toward the point and halt when the vehicles reach the line control measure. Note: if you create a control measure line so far away that the vehicles never reach it, the platoon executes the Move task frame, and then executes the Halt task frame when the vehicles finish their route.

Exercise 1: A Three-Phase Mission

1. Select **New Scenario** from the File pulldown menu.
2. Create a cross country route labeled "rt1".
3. Use the Line button to create two phase lines (PL1, PL2) that cross the route.
4. Create a platoon near the start of the route.
5. Assign the platoon a Move frame in default formation on the route (On Order - by default). Assign a Move frame on the same route but in a line formation in the next (Phase 2) execution matrix cell.
6. A 'Continue' button appears at the top and bottom of the execution matrix between the two task frame columns. Click this Continue button and select **Control Measure** from the menu and select PL1.
7. Assign the platoon a Move frame on the same route but in a staggered-column formation in the next (Phase 3) execution matrix cell.
8. A 'Continue' button appears at the top and bottom of the execution matrix between the two task frame columns. Click on this Continue button and select **Control Measure** from the menu and select PL2.
9. Select **Move** from the On Order pulldown menu at the top of the screen.
10. The platoon should travel the route and change formations at each phase line.

E.5.2 Set a Duration Transition

A duration transition occurs when a phase has been executing for a specified period of time.

1. Select **New Scenario** from the File pulldown menu.
2. Create a platoon and assign it a Move frame to a destination 10 km or more away (On Order - by default). Assign an Assemble frame in the next (Phase 2) execution matrix cell.

3. A 'Continue' button appears at the top and bottom of the execution matrix between the two task frame columns. Click on this Continue button and select **Duration** from the menu.
4. Enter in a time duration (for example: 1 min. 30 sec.).
5. Select **Move** from the On Order pulldown menu at the top of the screen. Notice that the timer appears.
6. The platoon should move toward the point and assemble when the time is up. The duration displays in the execution matrix while it counts down to zero. When the time is up, the duration will say that the duration has expired. Note: if you create a destination point so close that the vehicles reach it before the duration counts down to zero, the platoon executes the Move task frame and then executes the Assemble task frame when the vehicles arrive at the destination point.

E.5.3 Set an HHour Transition

An HHour transition occurs when a phase detects that a time before or after an HHour is reached.

With an HHour transition, the next phase in the execution matrix begins when the HHour time is reached. If the HHour clock is not defined, then the beginning of the next phase does not depend on HHour. However, the next phase does begin when the first phase ends on its own.

1. Select **New Scenario** from the File pulldown menu.
2. Use the HHour button to create an HHour clock whose HHour (exercise start) time is not yet set (change the Defined value to False).
3. Create a platoon and assign it a Move frame to a destination 10 km or more away (On Order - by default). Assign an Assemble frame in the next (Phase 2) execution matrix cell.
4. A 'Continue' button appears at the top and bottom of the execution matrix between the two task frame columns. Click on this Continue button and select **HHour** from the menu.
5. In the HHours editor, select the the HHour clock and set a positive time offset (for example: 1 min. 10 sec.). Notice that the transition now reads "<HHour clock name> + 0:01:10" to indicate that the second phase will begin 1 minute and 10 seconds following the HHour time that is defined with the HHour clock.
6. Use the HHours pulldown menu (top of the screen) to access your HHour clock. Set the HHour (exercise start) time to the current time (change the Defined value to Now).
7. Select **Move** from the On Order pulldown menu (top of the screen), and notice the expected transition time. The platoon should toward the point and when the time is up (meaning that the HHour time plus offset has been reached), the platoon will assemble. Note: if you create

a destination point so close that the vehicles reach it before the expected transition time, the platoon executes the Move task frame, but does NOT begin the assemble because the HHour plus offset condition is not satisfied.

E.6 Miscellaneous Exercises

E.6.1 Pending Mission

You can create a pending mission before or while a unit is executing a mission. Assign the pending mission whenever you want it executed. Once assigned, it replaces the current mission which is no longer available.

1. Select **New Scenario**.
2. Create two parallel cross-country routes (RT1, RT2).
3. Create an M1 tank platoon. Set an On Order Move task frame on RT1 at the default speed and formation. The platoon moves when you issue the On Order.
4. While the unit is traveling on RT1, click the Edit Pending Mission toggle. Select an On Order Move mission on RT2 as the pending mission by filling out the execution matrix.
5. Use the Assign Mission button to assign the pending matrix once the vehicles have moved on RT1 for a time. The platoon halts at the current location, waiting for the On Order authorization to execute the pending mission.
6. Issue the On Order Move for the RT2 task frame. Verify that the unit travels RT2.

E.6.2 Reaction to Indirect Fire

A moving ground unit can temporarily accelerate in response to an indirect fire burst within 50 meters of one of its vehicles.

1. Select **New Scenario**.
2. Create a cross-country route.
3. Create an M1 tank platoon. Assign an On Order Move task frame on the route at the default speed and formation. The platoon moves when you issue the On Order.
4. Click Speed in Map Notations from the PVD Controls editor.

5. While the unit is traveling the route, use the Artillery button to drop artillery around the platoon. If the artillery burst is close enough the platoon should increase its speed.
6. Turn off Speed in Map Notations.

E.6.3 Reaction to Contact for RWA

1. Select **New Scenario**.
2. Click Altitude and Speed in Map Notations from the PVD Controls editor.
3. Create an AH-64 flight.
4. Issue an **Occupy Position** mission. After the RWA are hovering in position:
5. Place enemy tanks, with fire permission set at Hold, in front of the RWA. RWA, when occupying a position and facing an approaching enemy, react with an attack.
6. Turn off Speed and Altitude in Map Notations from the PVD Controls editor.

E.6.4 Calling in Close Air Support (CAS)

1. Select **New Scenario**.
2. Create a pair of A-10 aircraft.
3. Create a T72 company (use a company since attrition is high from A-10 fire) .
4. Place the aircraft arbitrarily within 10 km of an A-10.
5. Task the A-10 aircraft with a unit-level CAS mission.
6. Provide an arbitrary route and refuel point.
7. At some point during the A-10 flight, use the Fire Support editor to call in a CAS mission on the T72 company. This is done by setting message type to Air Support, the "Gun" to one of the A-10s, and the location in close proximity to the T72 company.
8. Verify that the A-10s attack with numerous runs.

E.7 Scenario Exercises

E.7.1 Red Air Scenario Creation

1. Select **New Scenario** from the File pulldown menu.

2. Do the following:

```
Create one RWA (Mi24) at the NW corner of the terrain database.

Create one route from the NW corner to the map center.
Label it rh01rt.

Use the Execution Matrix to instruct the M124 to do an On Order Fly Route
mission on rh01rt.  You want the RWA to fly for 3 minutes, hover for 1
minute, and then land.

Create one FWA (MIG29) at the SW corner of the terrain database.

Create one route from the SW corner to center.  Label it rp01rt.

Give the FWA an On Order Ingress mission on bp01rt.
```

3. Save the scenario as xrair.
4. Select **New Scenario** from the File pulldown menu.
5. Load the xrair scenario.
6. Issue the On Order authorizations to verify that the operation succeeded.

E.7.2 Add Blue Air to Scenario

1. Select **New Scenario** from the File pulldown menu.
2. Load the xrair scenario.
3. Do the following:

```
Create one RWA (AH-64) at the NE corner of the terrain database.

Create one route from NE corner to center.  Label it bh01rt.

Assign the AH-64 an On Order Fly Route mission on bh01rt.
You want the rwa to fly for 1 minute and 15 seconds, hover for 1
minute, and then land.

Create one FWA (F14D) plane at SE corner.

Create one route from SE to center.  Label it bp01rt.

Assign the F14D an On Order Ingress mission on bp01rt.
You want the plane to fly for 1 minute and 30 seconds,
and then return to base.
```

4. Save the scenario as addxbair.

5. Select **New Scenario** from the File pulldown menu.
6. Load the addxbair scenario.
7. Issue On Order authorizations to see if your aircraft do what you intended.

E.8 Movement Exercises

Perform these exercises on the Fort Knox database. These exercises require a configuration of a single pocket ModSAF (gui/sim) running without the network (-nonet). Note: you do not need to wait for an exercise to end before starting the next one.

E.8.1 Bridge Crossing

1. Select **New Scenario** from the File pulldown menu.
2. Create an M1 platoon at ES5985, facing North, in wedge formation.
3. Create a line from ES591852 to ES630870 as the route.
4. Use the Execution Matrix to assign the Move frame.

What to look for:

- Vehicles should stay together.
- All vehicles should successfully cross the bridge.
- Vehicles maintain a wedge formation, except when going through narrow passages, or when approaching bridge.
- Vehicles do not collide.
- Vehicles all complete route.

E.8.2 Tree Canopy Avoidance

1. Create an M1 platoon at ES6689, facing North, in wedge formation.
2. Create a line from ES6589 to ES6693.
3. Using the Execution Matrix, assign a Move frame.
4. Set speed at 10 KPH.

5. Set formation to staggered column.
6. After a few minutes of movement, update the speed to 50 KPH.

What to look for:

- Vehicles should stay together.
- Vehicles should avoid the tree canopy.
- Vehicles should maintain formation, except when going through narrow passages, or taking corners.
- Vehicles do not collide.
- Vehicles all complete route.

E.8.3 River Crossing

1. Create an M1 platoon at ES850962, facing North, in wedge formation.
2. Place a point at ES851956.
3. Using the Execution Matrix, assign a Move frame to the point.

What to look for:

- Vehicles do not get stuck in the river.
- Vehicles do not collide.

E.8.4 Road Following

1. Create an M1 Platoon at ES848947, facing North, in wedge formation.
2. Create a road route from ES85019491 to 88969964.
3. Using the Execution Matrix, assign a Road March frame.
4. Set speed to 60 KPH.

What to look for:

- All vehicles cross the bridge.
- Vehicles do not collide.
- All vehicles complete the route.

E.8.5 Chase Point

1. Create an M1 vehicle at ES6394283230.
2. Click on the vehicle.
3. Click on the vehicle's green chase point.
4. Move the chase point to ES64058328, with direction 5750 Mils.

What to look for:

- Vehicle reaches the chase point facing in the correct direction.
- Vehicle does not collide with any buildings or get stuck in river.

E.9 Firing Exercises

E.9.1 Basic Assault

1. Select **New Scenario** from the File pulldown menu.
2. Create an M1 platoon and assign an Assault frame with a standard set of parameters including an objective.
3. Variation
   - Change the speed parameter using the "Modify Temporarily" option and verify that the unit assumes the correct speed.
   - Execute the assault in the absence and presence of enemy.

What to look for:

- The vehicles in the platoon should get on line and advance to the assault location.

E.9.2 Assault with a Route

1. Select **New Scenario** from the File pulldown menu.
2. Create an M1 platoon and assign it an Assault frame with a standard set of parameters including a route to follow.
3. Variation
   - Increase the speed with an Immediate Intervention and verify that the unit accelerates.
   - Execute the Assault in the absence and presence of enemy.

What to look for:

- The vehicles in the platoon should get on line and follow the route to the assault location.

E.9.3 Actions on Contact Task

1. Select **New Scenario** from the File pulldown menu.
2. Create an enemy T72M platoon behind a tree canopy.
3. Create an M1 platoon.
4. Give a Move mission to the M1 platoon using a route that takes the unit past the concealed enemy T72M platoon. When the Contact Drill reaction starts, use the "Change reaction" option to set the Action Drill Reaction parameter in the Actions on Contact task to Withdraw.

What to look for:

- When an M1 vehicle detects the enemy, the M1 platoon performs a Contact Drill reaction which set its Fire permission to "Free".
- During the Withdraw, the M1 platoon fires smoke grenades and backs away from the enemy.

E.9.4 Stop to Shoot Behavior

1. Select **New Scenario** from the File pulldown menu.
2. Create a BMP1 and an M1 in locations where they can not see each other.

3. Give the M1 "Hold" fire permission.
4. Give a Move mission to the BMP1. Use a routes that takes the vehicles within view of each other.
5. Click **Speed** in "Map Notations" on the PVD Controls Editor to turn on the display of speed.
6. Give the On Order(s).
7. After the engagement, click **Speed** in "Map Notations" on the PVD Controls Editor to turn off the display of speed.

What to look for:

- When the BMP1 vehicle detects the enemy, its speed goes to zero.
- BMP1 speed remains at zero until the BMP1 destroys the M1 or has no more Sagger missiles left.
- At that time, the BMP1 resumes moving along its route.

E.10 New Feature Exercises

E.10.1 Trigger Line in Occupy Position

1. Create a platoon of M1s in an area that has good intervisibility. Turn their fire permissions to hold.
2. Assign the M1 platoon a Hasty Occupy Position. Give them a line for the battle position, and an engagement area. Then give them a line for the secondary battle position, and a point for the secondary engagement area. Create a line for the trigger line, making sure that there is intervisibility between the battle positions and the line. Set the unit size to watch for to a platoon.
3. Give the On Order and let the tanks move to positions.
4. Modify the Actions on Contact task of the Hasty Occupy Position mission to set the Action Drill reaction to "No Action".
5. Create a platoon of T72s, with all fire permissions set to Hold. Assign the T72 platoon a Move mission to a location which will make them cross the trigger line.
6. Give the On Order to let the T72 tanks move.
7. Modify the Actions on Contact task of the T72 platoon Move mission to set the Action Drill reaction to "No Action".

8. When the T72s cross the trigger line, the platoon of M1s should move to its secondary battle position.

E.10.2 Specified Unit Control Measures

1. Create two M1 tanks.
2. Give one M1 a Halt mission. Then give it a Move mission in the next phase. Change the phase transition criteria (enabling task) to be "Control Measure" rather than "Continue," creating a line near the second M1 to be the control measure, and specifying the second M1 as the unit to watch.
3. Use the terrain tool to make sure the first M1 can see the control measure.
4. Give the second M1 a Move mission that will make it cross the control measure.
5. Give the On Order. Ensure that the first M1 doesn't start its move until the second M1 crosses the control measure.

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